



Essays on International Trade and Political Economy

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ABSTRACT

This dissertation consists of two essays in international trade and one essay in political economy.

The first essay analyzes the role of firm-level and country-level reputation for quality in international transactions. It studies the entry and pricing strategies of high-quality and low-quality exporters when buyers cannot observe the quality of a product prior to purchase. In a steady-state industry equilibrium, country reputations are endogenously set by the quality of their exports, leading to the possibility of multiple equilibria and low-quality traps. We show that export subsidies have a positive long-run effect on average quality, reputation and welfare in countries exporting low-quality goods. However, they have the opposite consequences in countries that export high-quality products. We present some evidence consistent with the model in the empirical pattern of US export prices.

The second essay studies the choice between home country and host country financing for multinationals facing demand uncertainty. Three main channels are identified. The cost of capital depends on local financial development. A diversification channel arises from the ability of geographically diversified firms to generate more stable cash flows. By contrast, contagion risk may result in inefficient liquidations

when firms raise funds exclusively on their home market. In particular, the model predicts that the prevalence of affiliate production and the share of parent finance should increase with the correlation of business cycles between the home and host markets. Moreover, exchange rate risk tilts the financing decision towards local debt.

The third essay deals with the emergence of mass education. Using data from the last 150 years in 137 countries, we show that large investments in primary education systems tend to occur when countries face military rivals or threats from their neighbors. Interestingly, democratic transitions are negatively associated with education investments, although democratic political institutions magnify the positive effect of military rivalries. These empirical results are robust to a number of statistical concerns and hold when we instrument military rivalries with commodity prices or rivalries in a given country's immediate neighborhood. We also present historical case studies, as well as a simple model, that are consistent with the econometric evidence.

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1. IMPROVING “NATIONAL BRANDS”: REPUTATION FOR QUALITY AND EXPORT PROMOTION STRATEGIES¹

1.1 *Introduction*

Why are consumers willing to pay more for indistinguishable “Made in Germany” than “Made in China” products? In which way is building a solid reputation for reliability and quality key to a developing country’s economic success – and how can it be achieved? Conversely, can a history of exporting cheap low-quality goods be an obstacle *per se* to national development strategies aimed at upgrading quality over time? These questions find no clear answers in standard models of international trade, which assume that consumers are perfectly informed about the characteristics of every available product and leave no role for country reputations. However, as an old and large literature on experience goods has shown, starting with Nelson (1970), quality is not fully known to consumers prior to purchase for a wide range of goods. Inferring the quality of a good on offer requires time, and is achieved both through search and through experience. For these categories of goods, country-of-origin affects product evaluations and consumers’ decisions. Indeed, many survey-based studies in the marketing literature, summarized by Roth and Diamantopoulos (2009), emphasize the role of country-of-origin labels in setting consumer perceptions of quality.

¹ Joint with Julia Cagé, Harvard University and Paris School of Economics.

In this paper, we argue that a “national brand image” matters because it provides an anchor for the expected unobservable quality of imports. Consumption decisions, in practice, are based on a limited information set about the characteristics of goods or varieties. To understand the determinants of demand faced by entrants as well as incumbents in an industry, we need to consider the information available to consumers at the time of purchase: information gathered as a result of past consumption experience and word-of-mouth diffusion, but also the producer’s brand name, and the country where the good was manufactured. Together, these elements determine perceived quality, which affects consumption more than true quality when the latter is not observable. Specifically, for new and unknown foreign brands, the main piece of information available to consumers is the “made in” label, which indicates the country of manufacturing, and creates a key role for national reputations. We call “national reputation” the common component of consumers’ perceptions of the quality of goods produced within a given country. Usual examples of such priors are the widespread perceptions that “German goods last a lifetime” or “Chinese goods break down quickly”. Country reputations determine the quality that buyers expect from a product before they learn any information specific to this variety. In the long-run, they should adjust to the the actual average quality of exported goods.

Indeed, using newspaper content analysis to proxy for national reputations, we provide some evidence that a better reputation is associated with higher unit prices on exports to the US, after controlling for other determinants of within-sector vertical specialization across countries. Moreover, this relationship is stronger for sectors with more quality differentiation, which lends support to the asymmetric information foundation of our model.

We proceed to analyze the impact of asymmetric information concerns on the

demand for imported goods and on the long-run quality composition of a foreign country's exports. Quality uncertainty leads to consumption patterns where both brand reputation and country-of-origin matter, and where incumbents are able to charge higher prices than unknown brands. As long as quality is gradually observed through consumption, asymmetric information about quality distorts demand, compared to the perfect information case, relatively more for new entering firms without established brand names. It raises profits of low-quality firms benefiting from good country-of-origin labels, but is an obstacle to exporting for high-quality firms unable to signal their type in low-reputation countries. Broadly speaking, we are addressing three main questions. First, how does a poor "national brand" act as a barrier to entry into foreign markets? Second, under which conditions do quality expectations have self-fulfilling effects, keeping some exporting countries into low-quality traps? Finally, which policy instruments can help countries overcome the adverse impact of such information asymmetries?

More specifically, we consider a two-country model with a continuum of potential foreign exporters heterogeneous in quality, and a constant flow of new entrants per period. Quality is exogenous and known to firms but not observed by consumers before purchase. Hence, import demand depends on perceived quality, which has two components. Goods imported from a given country are first evaluated according to a country-wide prior, which is determined by the average quality of the country's exports in a long-run industry equilibrium. Importers then learn about the true quality of firms that have exported in the past. The fraction of informed consumers increases with the time a firm has been active on the market. The effect of the country prior will thus prevail for new exporters, and fade over time as buyers gain familiarity with individual foreign brands. On the supply side, potential foreign exporters decide

whether to enter the market and when to exit, taking into account the impact of their decisions on expected future sales. If active, they sell at a price determined by the buyer's quality expectation. We assume that the cost of producing one physical unit of the good is monotonically increasing in quality, but the cost per quality-adjusted unit is decreasing in quality. Thus, although our focus is on vertical differentiation, quality and productivity are positively related in our model.

Our main channel is a distortion in entry and sales due to unobservable quality. Asymmetric information fosters entry by low-quality firms, which earn higher profits than under perfect information by free-riding on high quality expectations. It depresses profits of the highest-quality firms, forced to incur initial losses in order to reveal information about their type. At the industry level, there are two types of steady-state equilibria with endogenous country reputations. In a high-quality, high-reputation equilibrium, imperfect information does not hinder entry of high-quality firms into export markets, but generates excess entry by low-quality firms. In a low-quality, low-reputation equilibrium, a range of firms with above-average quality are permanently kept out of the market by the informational friction. With costs too high to allow for positive profits in the first periods, and quality too low for initial losses to be recouped with future profits, this set of firms choose never to be active. Furthermore, there can be multiple low-quality equilibria, such that countries with bad quality reputation can be locked into exporting low-quality, low-cost goods.

The model yields interesting policy implications. In particular, imperfect information about the quality of imported goods provides a justification for export promotion policies in economies specialized in low-quality products. Some export-led growth strategies for developing countries, pursued in the past by East Asian economies, rely on exporting low-quality, low-cost goods and gradually moving up to higher

quality, higher unit value goods². China is attempting to follow the same path. Without policy intervention, though, we show that it may not be feasible if the economy is trapped in a self-fulfilling low equilibrium, in which the country's reputation for low quality prevents high-quality firms from entering export markets. A successful export promotion policy then involves either subsidizing exporters' initial losses, or investing public resources into raising the country's perception abroad. Indeed, we find that export subsidies improve the average quality of exports, raise unit prices received by exporting firms, and have a positive welfare effect in countries that are initially in a low-quality equilibrium³. However, subsidies have the opposite long-run effects in countries exporting high-quality goods. In the latter case, the induced entry by low-quality firms creates a negative externality on all exporters, lowering average quality, reputation and aggregate profits.

Moreover, we show that large reputation shocks, for instance triggered by heavily mediatized events or by a government-sponsored national promotion campaign, can have self-fulfilling features. Small reputation shocks only have short-lived effects. But when there are multiple steady-states, a large positive reputation shock in a low-quality equilibrium raises prices received by all firms and allows more firms with above-average quality to enter, thereby driving up the true average quality of exported goods. Reputation and quality increase jointly until the economy settles in a higher

² We dwell in more detail on the Japanese and South Korean examples in section 1.2.

³ The case for export subsidies is mixed in the existing literature. Brander and Spencer (1985) first introduced the idea of welfare-enhancing subsidies in a Cournot strategic rivalry, and Greenwald and Stiglitz (2006) developed an infant-industry argument for protective trade policy. Flam and Helpman (1987) find that the desirability of export subsidies is ambiguous, depending on the production structure. Demidova and Rodríguez-Clare (2009) show that subsidies improve productivity in a model with heterogeneous firms, but are nonetheless detrimental to welfare due to losses in terms of trade and variety. Recently, Aghion, Dewatripont, Du, Harrison, and Legros (2011) make a more specific case for targeted industrial policy towards more competitive sectors. The main arguments for active trade policy relying on coordination failures and externalities are reviewed and assessed in Harrison and Rodríguez-Clare (2009).

steady-state.

This paper relates to two main strands of literature. In a closed economy framework, several early papers (Shapiro, 1983; Riordan, 1986; Farrell, 1986; Liebeskind and Rumelt, 1989) have studied entry and pricing strategies for experience goods, for which quality is unobservable a priori and is only revealed through repeated consumption. Bergemann and Välimäki (1996, 2006) incorporate the experimentation and learning processes by consumers. Furthermore, there is evidence of the benefits of a reputation for quality in terms of brand premia (Imbs, Mumtaz, Ravn, and Rey, 2010) and image spillovers across products of the same brand (Sullivan, 1990). We develop these insights further by considering the demand for imports, where initial priors depend on country-of-origin and reputations are built not only for specific firms but also for exporting countries as a whole.

In the international trade literature, vertical quality differentiation has recently been studied by Baldwin and Harrigan (2007); Johnson (2010); Verhoogen (2008); Hallak and Sivadasan (2009); Kugler and Verhoogen (2011); Manova and Zhang (2011) and Fajgelbaum, Grossman, and Helpman (2009). However, these papers assume perfectly observable quality and deal with the choice of quality by exporters. Instead, we abstract from the endogenous quality choice by firms and study the implications of asymmetric information on the equilibrium quality range of exports.

The literature most closely related to this paper deals with the policy implications of asymmetric information about the quality of foreign goods. Grossman and Horn (1988) examine the infant-industry argument in a two-period model with moral hazard in the choice of quality, and find no case for temporary or permanent protection. However, the extensive margin of trade in their model concerns only low-quality firms, while we show that a subsidization policy can also encourage entry by high-

quality firms in an infinite-period setting with overlapping generations of firms. Bagwell and Staiger (1989) point out that asymmetric information may lead to insufficient entry by high-quality firms; but they focus on a single-firm, single-consumer interaction with two quality levels, and do not allow for reputation externalities between firms. We will show that these externalities, from the entry decisions of heterogeneous firms to buyers' beliefs, lie at the core of the effects and policy implications of unobservable quality. Chisik (2003) develops the idea of a "reputational comparative advantage" whereby country labels act as a coordinating device for exporters, but also assumes away within-country reputation externalities by building a single-firm model. Lastly, Dasgupta and Mondria (2011) develop a two-period model with similar features to ours, where the quality of new exporters is unobservable and that of continuing exporters is known by a fraction of consumers. However, their paper deals with firm reputations and the role of intermediaries in providing quality assurance, taking as given the first-period price. We take the analysis further by endogenizing country reputations in an infinite-horizon setting and characterizing steady-state equilibria.

Other papers introducing imperfect information in trade have addressed different issues such as uncertainty about demand conditions for firms entering a foreign market (Hoff, 1997; Segura-Cayuela and Vilarrubia, 2008), reputation-building for distributors in the importing country (Araujo and Ornelas, 2007), or marketing costs incurred to make consumers aware of the existence of foreign goods (Arkolakis, 2010). Rauch and Watson (2003) focus on the tendency of buyers in developed countries to start small in building partnerships with suppliers in less developed countries, in order to learn about their ability to fill large orders. Finally, there are some empirical studies of the effect of perceptions of foreign countries on trade flows. Guiso,

Sapienza, and Zingales (2009) and Disdier and Mayer (2006) find a relationship between bilateral trust or bilateral opinions and imports, but do not consider the quality aspect of countries' reputations. Specific reputation shocks have only been analyzed through event studies, such as the negative perception of France in the US at the onset of the Iraq war (Michaels and Zhi, 2010), and recalls of Chinese toys (Freedman, Kearney, and Lederman, 2009).

The remainder of this paper proceeds as follows. Section 1.2 presents motivating historical evidence and stylized facts on the importance of national quality reputation for exporters. Section 1.3 lays out our modelling framework and Section 1.4 analyzes high-quality and low-quality steady-state equilibria with endogenous reputation. Section 1.5 explores the effects of export promotion policies on quality, reputation and profits. Finally, section 1.6 concludes.

1.2 *Empirical motivation*

1.2.1 *Historical motivation: Creating "National Brands"*

Since their creation, country-of-origin labels have been related to protectionist concerns. When the "Made in Germany" label – now an internationally recognized signal of quality – was introduced, it was as a policy instrument against German exports. The label was originally created in the United Kingdom by the Merchandise Marks Act of 1887 to signal foreign products, then considered by the British society as inferior to domestic ones. Ironically, a few years later, in 1894, a commission of the German Reichstag reported that German manufacturers found the label to be of good use: having achieved superior quality, they were better able to distinguish themselves from British manufacturers. Even more surprisingly, as reported by Umbach (2003), *"English manufacturers even began to forge the label, printing it on their*

English-made products". The "Made in Germany" label had turned from a signal of poor quality into a signal of the best quality.

Similarly, at the end of World War II, "Made in Japan" goods had a reputation for being cheap low-quality goods. Japanese companies were suffering from an inferior "national brand". On the contrary, currently, Japanese cars and electronics are ranked among the most reliable in all consumer surveys. More generally, Japan's pattern of specialization in manufactures has evolved dramatically, shifting from unskilled labor-intensive goods to human capital and R&D-intensive products (Balassa and Noland, 1989). Japanese companies achieved such a dramatic change by privately imposing strict quality norms. They formed export cartels which provided product quality guarantees, by setting product design and quality standards, establishing industry brand names, guaranteeing delivery schedules, and mediating disputes between individual exporters and foreign buyers (Dyck, 1992). Providing product quality assurances to importers stimulated growth in exports and improved terms of trade. Hence, as argued by Lynn and McKeown (1988), the ability to establish collectively a reputation for product quality was key to Japan's export success. This ability was the outcome of both private companies and government initiatives: in the public policy realm, not only did antitrust laws permit the formation of export cartels, but export restrictions were exercised under the Control Law⁴.

Government initiatives also played a key role in the shift in South Korea's pattern of trade specialization since the 1970s. Public investment subsidies were tied to exporting activity, as Korean governments were determined to favor the emergence of

⁴ The first paragraph of Article 48 of this law sets that *"any person desiring to export goods of any designated type, or goods destined for any special areas, or to export goods by means of any designated form of transaction or payment, may be required to obtain the approval of the Ministry of International Trade and Industry"*. (Matsushita, 1979)

the country on the international trade scene⁵. These policies resulted in the channeling of credit at negative interest rates to South Korean conglomerates and provided them with insurance against business risk, particularly in the export market (Aw, Chung, and Roberts, 1998). This export-led development strategy is often pointed as having been the hallmark of East Asian miracle growth (e.g. World Bank, 1993). Incidentally, Korea's determination to play a growing international role was showcased by hosting the Olympic games in Seoul in 1988. From a historical point of view, the 1988 Olympics symbolized the success of over three decades of active government intervention in the economy⁶.

In a similar way, the 2008 Beijing Olympics reaped a huge prestige bonanza for China, being (again) the most-viewed televised event ever – in the United States, the cumulative audience amounted to over two-thirds of the population – and representing China's grand entrance onto the world stage. However, an interesting takeout of this example is also its limitations. China is struggling to move up the value chain in its exports⁷. Although a large-scale national promotion event can help improve a country's image abroad, it is far from sufficient to overcome a bad reputation when the economy seems stuck in a low-quality trap, whereby high-quality firms suffer from the country's reputation in their attempts to export. The strategy of Lenovo, the only Chinese company to get a worldwide sponsorship for the 2008 Beijing Olympics,

⁵ Pack and Westphal (1986), Westphal (1990), Levy (1991), and Rodrik (1995) have documented the importance of government investment subsidies in Korea.

⁶ On September 17, 1988, over a billion people worldwide watched the Olympics opening ceremony, telecast from Seoul, the then largest television audience in history (Larson and Park, 1993) and a global advertisement for the country's image. South Korea *"emerged from the Games in triumph both as host and competitor. (...) [It] has been bent on showing the world that it is no longer a place to overlook. The Games are only part of that"* (New York Times, 10/08/1988).

⁷ E.g. Schott (2008) documents that the prices that US consumers are willing to pay for Chinese exports are substantially lower than the prices they are willing to pay for OECD exports in the same product category; furthermore, the gap or "OECD brand premium" has been increasing over time.

is revealing in this respect. With a Western-sounding name, the legacy of the I.B.M. brand name and technology, and a chief executive who hails from Dell and NCR, the Lenovo Group is not a company that most Americans would assume is Chinese. This is exactly what the company aims for (although Lenovo's largest shareholder is the Chinese government), aware of the fact that the typical American consumer associates Chinese products with cheap and unreliable: *"They want to be viewed as a global company, not a Chinese company, in the West or they'll never be able to beat the cheap rap"*.⁸ Hence, whether China can, in the coming years or decades, successfully follow the same path as Japan and South Korea in the past, remains an open question.

1.2.2 *Stylized facts: National reputations and unit prices*

Moving beyond anecdotal motivations, we provide some additional evidence of the importance of country-of-origin reputations in current trade patterns. This section shows that the quality of a country's exports, as measured by unit prices, is not only determined by observable fundamentals such as the country's income level and factor endowments. Perceptions, mediated by news sources, also seem to play a role – either because the media are a supplier of information beyond observable country characteristics, or because of a pure reputation effect. Both of these interpretations are associated with asymmetric information in the demand for imports, which is the foundation of our model.

More specifically, news coverage of a country provides a proxy for national reputations. For consumers, the media are providers of information about safety scandals or successful businesses in foreign countries, work practices, and the general reliability of foreign goods. For firms sourcing inputs from foreign suppliers, news also re-

⁸ *New York Times*, 06/20/08.

flect information relevant to risks of delays, disruption of supply chains, or corruption practices, which affect their expected value from the importer-exporter relationship. Our working hypothesis is that media coverage is a channel through which country perceptions are formed, confirmed or changed, affecting the demand for goods produced in countries that receive massive positive or negative news coverage⁹. We establish that controlling for the determinants of unit values and specialization into higher-quality goods that have already been identified in the literature, better reputation is associated with higher unit prices on exports. This relationship does not need to be interpreted causally but rather as an equilibrium outcome under asymmetric information: in our model, the relationship between the national reputations of exporting countries and the quality of their exports will run both ways to generate a price-reputation dependence.

Data

We collect news coverage data from the Factiva database, which comprises over 31,000 news sources. We developed a script that searches all US news and business publications for articles covering a given foreign country, in a given year, and including a keyword from a list of relevant terms¹⁰. We gather data on 146 countries over 1988-2006, excluding countries of less than 1 million inhabitants, which receive almost no coverage in US media. The list of 116 keywords was identified through a systematic listing of recurring terms and phrases in the coverage of foreign countries

⁹ This empirical approach is inspired by the literature on media bias. The broad insight from this growing literature is that media coverage affects real outcomes, such as voting (Della Vigna and Kaplan, 2007), political participation (Gentzkow, Shapiro, and Sinkinson, 2011), political accountability (Besley and Burgess, 2002), or stock market reactions to earnings announcements (Dyck and Zingales, 2003).

¹⁰ Or any word sharing the root of the keyword. For instance for the keyword “counterfeit”, the script also searches for “counterfeited”, “counterfeiting”, etc.

and companies in the *New York Times*, the *Wall Street Journal*, *Business Week* and the *Boston Globe*. We sort them into four categories. The “political” category relates to the foreign country’s general political context, and is split between positive terms (e.g. “democratic transition”) and negative terms (e.g. “corruption”). The “quality” category deals specifically with quality issues, improvements or scandals; we also distinguish between positive (e.g. “quality control”) and negative (e.g. “class-action suit”) terms¹¹. To avoid misclassifying negative articles as positive and vice versa, we exclude articles where a negating word appears around the keyword. For quality-related keywords, we conduct the searches both at the aggregate country level and in articles dealing with specific industries for 11 sectors¹².

We obtain the number of articles published in US news sources with positive or negative keywords per country-year for political and quality categories, and per country-year-industry for quality categories. We define current news variables with the number of articles in each category in the current year. Article counts are normalized by the sum of all articles in the same category and same period across countries. The normalization accounts for the positive trend in the number of articles in the database over time.

¹¹ Examples of search results on China are: “World briefs - Houston Chronicle, 31 December 1996, 486 words, (English) ... BEIJING - China is preparing this week to carry out a series of legal reforms hailed by some as a step toward greater rule of law and protection of individual rights. ...” (political, positive); “Brilliance China Automotive Holdings Limited Announcement - PR Newswire, 5:16 AM, 31 December 2003, 3733 words, (English) ...relationship with the JinBei group of companies and will be in a better position to monitor and exercise more stringent quality control over the automotive components that it purchases from the JinBei group of companies. Accordingly, the Directors consider...” (quality, positive).

¹² Aerospace/Defense; Automobiles; Chemicals; Clothing/Textiles; Computers/Electronics; Consumer Products; Food/Beverages/Tobacco; Machinery/Industrial Goods; Paper/Packaging; Pharmaceuticals; and Telecommunications.

Specifically, for country c , industry i , year t and $k \in \{\text{positive, negative}\}$:

$$industry\ quality\ news_{c,t,i,k} = \frac{\# \text{ quality articles}_{c,t,i,k}}{\sum_c \# \text{ quality articles}_{c,t,i,k}}$$

$$political\ news_{c,t,k} = \frac{\# \text{ political articles}_{c,t,k}}{\sum_c \# \text{ political articles}_{c,t,k}}$$

We match the news data with US import data at the 5-digit SITC level from Robert Feenstra, described in Feenstra, Romalis, and Schott (2002). We calculate f.o.b. unit values at the 10-digit HS level where quantity units are homogeneous across observations. We then construct sectoral indices of export unit values for each country c by taking averages, across all 10-digit products exported in the 5-digit sector, of c 's unit prices relative to those of all countries exporting the product to the United States.

Our independent variables include gravity variables from CEPII¹³ and international and civil conflicts from the Correlates of War database. The correlation of votes at the United Nations General Assembly controls for the degree of political alliance with the United States. Following Schott (2004) on the determinants of unit prices, we include the capital/labor ratio of the exporting country and the fraction of its population having achieved at least secondary education. These data are constructed respectively from Penn World Tables 7.0 and from Barro and Lee (2010). Finally, the length of quality ladders from Khandelwal (2010) measures the extent of quality variation, and therefore the scope for vertical differentiation, within 5-digit sectors¹⁴.

¹³ Distance, GDP, population, common border, common official language, former colonial ties, common legal origin, common currency and GATT/WTO membership; from Head, Mayer, and Ries (2010). Note that GDP, market size and remoteness are also determinants of firms' choice of export quality across destinations, as shown by Manova and Zhang (2011).

¹⁴ Khandelwal estimates the quality of US imports from price and market share data. Conditional on price, a product with higher market share is assigned higher quality. In our framework, it is more precisely a measure of perceived quality. The scope for vertical differentiation (length of quality ladders)

Table 1.1: **Summary statistics**

	Mean	St. dev.	Min	Max
Export unit value index	89.287	107.237	0.002	2795.957
Positive industry quality news	3.167	4.229	0	93.574
Negative industry quality news	3.126	3.578	0	40.323
Quality ladder	2.072	0.8776	0	5.803
Capital/labor ratio	60.952	36.482	0.438	153.856
Skilled fraction of population	50.161	19.156	2.001	92.656
UN vote correlation	0.223	0.347	-0.680	0.882

Table 1.1 provides some descriptive statistics.

Unit prices, reputation and quality

Table 1.2 reports the results of the industry-level specifications. As mentioned above, we include as independent variables GDP per capita, capital/labor endowment and education attainment, which affect the quality range of a country's production. We also include year and sector fixed effects and cluster standard errors by country. We show that export unit values, after controlling for these and gravity variables, are correlated with the type of news that appear in US printed media about the exporting country and its companies.

In column 1, we find that within industries, countries where a sector receives bet-

is then calculated from the heterogeneity in estimated product qualities within products.

Table 1.2: Export unit prices and industry news coverage

	Unit value index					
	(1)	(2)	(3)	(4)	(5)	(6)
Pos. industry quality news	0.035*	0.006	0.046	0.016	0.030*	0.000
	[0.018]	[0.019]	[0.030]	[0.029]	[0.016]	[0.017]
Neg. industry quality news	-0.059***	-0.010	-0.053***	-0.007	-0.056***	-0.008
	[0.021]	[0.022]	[0.019]	[0.021]	[0.019]	[0.021]
Pos. quality news*ladder		0.015***		0.015***		0.015***
		[0.005]		[0.005]		[0.005]
Neg. quality news*ladder		-0.024***		-0.023***		-0.024***
		[0.006]		[0.006]		[0.006]
Total industry quality news			-0.008	-0.007		
			[0.025]	[0.025]		
Capital/labor ratio	-0.163***	-0.163***	-0.221***	-0.221***	-0.174***	-0.174***
	[0.053]	[0.052]	[0.061]	[0.061]	[0.054]	[0.054]
Skilled fraction of pop.	0.009	0.009	0.025	0.025	0.010	0.011
	[0.070]	[0.069]	[0.084]	[0.084]	[0.069]	[0.068]
UN vote correlation	0.252***	0.252***	0.282***	0.282***	0.230***	0.230***
	[0.084]	[0.084]	[0.089]	[0.089]	[0.084]	[0.084]
Pos. political news					0.099	0.098
					[0.064]	[0.064]
Neg. political news					-0.087	-0.086
					[0.060]	[0.060]
Gravity variables	yes	yes	yes	yes	yes	yes
Observations	157 906	157 906	143 024	143 024	157 906	157 906
R-squared	0.261	0.261	0.264	0.264	0.261	0.261

Year and industry FE. Clustered SE by country in brackets. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$
All news variables, capital/labor ratio and the skilled fraction of the population are in logs.

Table 1.3: Export unit prices and country news coverage

	Unit value index					
	(1)	(2)	(3)	(4)	(5)	(6)
Pos. political news	0.110 [0.069]		0.006 [0.062]		0.005 [0.062]	0.004 [0.056]
Neg. political news	-0.089 [0.064]		-0.052 [0.054]		-0.052 [0.055]	0.029 [0.041]
Pos. quality news		0.163* [0.088]	0.195** [0.086]	0.222** [0.088]	0.251*** [0.085]	0.423** [0.171]
Neg. quality news		-0.120 [0.075]	-0.119* [0.071]	-0.170** [0.083]	-0.166** [0.080]	0.005 [0.120]
Pos. quality news*ladder				-0.030 [0.021]	-0.029 [0.021]	-0.028 [0.021]
Neg. quality news*ladder				0.025 [0.021]	0.024 [0.021]	0.023 [0.021]
Total news						-0.421 [0.301]
Capital/labor ratio	-0.173*** [0.053]	-0.164*** [0.046]	-0.172*** [0.047]	-0.164*** [0.046]	-0.173*** [0.047]	-0.174*** [0.046]
Skilled fraction of po.	-0.004 [0.066]	0.009 [0.060]	0.021 [0.057]	0.009 [0.060]	0.021 [0.057]	0.023 [0.054]
UN vote correlation	0.155* [0.084]	0.170* [0.087]	0.142* [0.080]	0.170* [0.086]	0.142* [0.080]	0.138* [0.077]
Gravity variables	yes	yes	yes	yes	yes	yes
Observations	204 237	203 883	203 460	203 883	203 460	203 460
R-squared	0.261	0.262	0.262	0.262	0.263	0.263

Year and industry FE. Clustered SE by country in brackets. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$
All news variables, capital/labor ratio and the skilled fraction of the population are in logs.

ter coverage in US media charge higher unit values on the sector's exports, relative to countries receiving less favorable coverage. The coefficient is larger for negative quality news, about quality defects or scandals, than for positive news, about successes and quality control. We also find that unit prices are higher on imports from political allies (high correlation of UN votes) and lower on imports from countries with higher capital-labor ratios¹⁵.

In column 2, we interact the news variables with Khandelwal's quality ladder measure. A longer quality ladder implies that the sector has more dispersion in quality, hence is more vulnerable to concerns about unobserved quality. Consistent with our interpretation in terms of asymmetric information, we find that the effect of industry-level news is magnified in sectors where there is more scope for vertical differentiation. According to the point estimates, a 10% increase in the quantity of positive (respectively, negative) quality-related news relative to other foreign countries is associated with a 0.3% increase (respectively, 0.5% decrease) in the unit value of exports in a sector at the mean of quality ladders. For the sector with the longest quality ladder, i.e. the most vertical differentiation, the corresponding values are respectively a 0.8% increase and a 1.3% decrease in unit value.

It may be that these results are affected by the total volume of news coverage of a country if some countries are more heavily covered by US media because of a cultural or geographical proximity not captured by our controls, and are also more frequent and trusted trading partners. Controlling for the total amount of news concerning the country-sector pair, however, does not change any of the relevant coefficients

¹⁵ This result on capital-labor ratios seems to contrast with the existing literature. However, we can replicate Schott (2004)'s finding that higher capital-labor ratios are associated with higher unit values when the independent variables only include, beyond K/L , year and sector fixed effects, as in his paper. When we add country fixed effects or control for gravity variables, the positive coefficient on the capital-labor ratio disappears.

(columns 3 and 4). Finally, in columns 5 and 6, we include political news at the country level, and find insignificant coefficients, confirming that the most relevant information is quality-related news rather than general country images. Note that we already proxy for political goodwill towards foreign countries with the correlation of UN votes.

In Table 1.3, we repeat the exercise with aggregate country news per year instead of news covering specifically the industry, both political and quality-related. Again, we find that positive news about quality are associated with higher unit prices on exports, and negative quality news with lower unit prices. Political news coverage does not enter significantly after including the UN vote measure of alliances. The coefficients do not vary in a significant manner according to the length of quality ladders. Thus, these results seem to indicate that national reputations are formed at the country-sector level rather than at the overall country level.

To sum up, we have shown that countries with a better quality reputation, mediated by news coverage, have higher unit prices after controlling for known determinants of country-wide quality. The link is stronger in sectors with large scope for vertical differentiation, supporting our interpretation of country reputations as a component of expected quality. Naturally, although reputation shocks may not be directly related to changes in the actual quality distribution of a country's exports, long-run perceived and actual quality go hand-in-hand, and the contents of media articles are related to both. What we have shown is that after controlling for observable country characteristics, there is still a role for quality perceptions to influence unit prices. These results support the presence of imperfect information in international trade transactions. We proceed to formalize these insights in a model with asymmetric information.

1.3 Model setup

1.3.1 Firms

We develop a model with two countries, Home and Foreign. We focus on the industry equilibrium in an export-oriented sector in Foreign, for which Home is the importer. The industry is composed of overlapping generations of foreign exporters. We do not model explicitly the domestic market of foreign firms: all firms in the industry produce for export only¹⁶.

There is a constant number E of potential exporters being born every period. Each new firm draws a quality parameter θ from a distribution $G(\theta)$ with support on $[\theta_m, \infty)$ and density $g(\theta)$, and has the option to produce a good of quality level θ ¹⁷. At the beginning of every period, firms decide whether to stay active and export, or shut down. Each firm has capacity 1, so that it can choose to sell either one unit or nothing.

If it produces and sells, a firm j of type θ incurs a cost $w\theta + k$, including both production costs and trade and transport costs. k includes all costs that are independent of quality, while $w\theta$ is the portion of costs that increases with the quality of the product (e.g. quality control processes, better intermediate inputs, more skilled workers).

¹⁶ We could easily extend the model to allow firms to serve their domestic market as long as the decisions to enter the domestic and export markets are separable. The key assumption is that there is no information flowing between buyers located in different geographic markets. In particular, a firm having established a reputation in its domestic market would not be able to transfer this reputation to export sales.

¹⁷ For simplicity we do not model the choice of quality. We can think of the exogenous quality draw as determined on the domestic market before considering the decision to export, or as a technology blueprint which comes from an R&D process with uncertain outcome: all firms invest the same sunk cost in R&D and randomly, some come up with better quality products than others.

Hence, profits at period $t + s$ of a firm j born at date t are:

$$\pi_{t+s}(j) = p_{t+s}(j) - w\theta(j) - k \quad (1.1)$$

where $p_{t+s}(j)$ is the price at which firm j sells its output. The price-setting mechanism is described in the next subsection.

A firm can freely exit at any period and realize zero profits from this period onwards; however if it chooses to exit the export market in a given period, it cannot re-enter later¹⁸. Moreover, each firm has an exogenous probability $1 - \delta$ of disappearing every period, independent of both quality and the firm's age. The probability that a firm still exists from one period to the next, conditional on not choosing to exit, is δ . There is no additional discount rate.

1.3.2 Buyers

In Home, a pool of importers each demand one unit of the good. We assume that there are no tariffs or transport costs¹⁹. Potential demand for imported goods in Home is assumed to be large, in the sense that the market size is sufficient for all foreign exporters to find a buyer at a price that does not exceed the expected value of their goods. The true utility from consuming the product is θ , but is not observable before purchase. We can think of θ as characteristics that are observed only upon consumption, or for durable goods, as the inverse of the probability of breakdown per period.

At the beginning of every period, each active firm is randomly matched to a buyer

¹⁸ This assumption is inconsequential for the steady-state analysis. It rules out coordination problems among high-quality firms along the transition path.

¹⁹ Ad valorem tariffs are introduced in Appendix A.3.

in Home. The firm cannot sell to another importer in that period, nor can the buyer purchase from another exporter before the next period. The firm then sets the price equal to the expected value of the good for its buyer. The indirect utility buyer i receives from variety j is:

$$u^i(j) = \theta(j) - p(j) \quad (1.2)$$

which can be derived from an additively separable utility function where buyer i consumes a numeraire good and one unit of the imported differentiated good. As $\theta(j)$ is not observed, the maximum price that an importer i is willing to pay for the output of firm j at time $t + s$ is given by its expected quality from the perspective of the buyer:

$$p_{t+s}(j) = E_{t+s}^i [\theta(j) | I_{t+s}^i] \quad (1.3)$$

where I_{t+s}^i is the information set of buyer i at time $t + s$. We assume that firms hold all the bargaining power and receive the full expected surplus of the transaction²⁰.

There are two types of buyers, informed and uninformed. Uninformed buyers (noted U) have no information specific to firm j ; they do not know its quality or how long it has been an active exporter. The only information at their disposal is the “national reputation”, i.e. a prior μ_{t+s} about expected quality among all foreign exporters. μ_{t+s} is common across buyers. Informed buyers (noted I) know the true quality of firm j , either because they have past experience from consumption of good j or because they have received information from another importer who has. Hence,

²⁰ Also, long-term contracts between exporters and importers are ruled out in this setting: all contracts are one-period sales contracts and firms are matched to customers for one period only. In particular, there cannot be price schedules resembling an introductory pricing strategy, whereby buyers would pay a low price in the initial period and offer a sequence of prices contingent on their future consumption experience.

the relevant information sets of both types of buyers are:

$$\begin{aligned} I_{t+s}^U(j) &= \{\mu_{t+s}\} \\ I_{t+s}^I(j) &= \{\theta(j), \mu_{t+s}\} \end{aligned}$$

The price received by a firm j matched with buyer i in period $t + s$ is therefore equal to its quality if i is informed, and to the country's reputation if i is uninformed; so (1.3) can be rewritten as:

$$p_{t+s}(j) = \begin{cases} \mu_{t+s} & \text{if } i \in U \\ \theta(j) & \text{if } i \in I \end{cases} \quad (1.4)$$

In the first period when a firm j enters the market, all importers are uninformed about j . Then, if firm j has exported s times in the past, a fraction $\rho(s)$ of buyers are informed, where we make the following natural assumptions:

Assumption 1: $\rho' \geq 0$, $\rho(0) = 0$, and $\lim_{s \rightarrow \infty} \rho(s) = 1$.

The fraction of informed buyers increases as the firm gains export experience²¹. Note that a concave $\rho(s)$ would capture the idea that a firm having already exported is more likely to be matched again with one of its previous buyers or with someone close to a previous buyer in terms of informational diffusion; hence the rate at which the scope of informed buyers expands would decrease with the number of periods the firm has been on the market. However, the only conditions needed for our analysis is that ρ is monotonically increasing and takes values between 0 and 1.

²¹ A possible microfoundation for the $\rho(s)$ function is that importers belong to distinct groups within which information diffusion takes place. The fraction of informed buyers rises according to the probability of sampling a buyer from an uninformed versus an informed group. See Appendix A.2 for a formal development.

For expositional simplicity we will drop the j notation in the next sections and refer to “firm θ ” instead of “firm j with quality parameter θ ” whenever possible.

1.3.3 Timing

For a given cohort of firms born at date t , the timing of moves is as follows:

- At t , each new firm j draws a parameter $\theta(j)$ and decides whether to export or not.
- For each $s \geq 1$, at time $t + s$:
 - Each active firm j is matched with a buyer i and observes whether i is informed or uninformed.
 - The price is set at $E_{t+s}^i [\theta(j) | I_{t+s}^i]$, and production and sales take place.
 - For each good j that was sold, the fraction of informed buyers rises from $\rho(s)$ to $\rho(s+1)$.
 - The exogenous death shock is realized. Firms that survive decide whether to stay active.
 - New firms are born (cohort $t + s$).

1.3.4 Perfect information

Under perfect information, all $\theta(j)$ are observable by all parties. All firms receive a price $p_{t+s}^*(j)$ equal to true quality regardless of how long they have been exporting:

$$p_{t+s}^*(j) = \theta(j) \text{ for all } s$$

Therefore, it follows from (1.1) that firms are active exporters if and only if $\theta \geq \theta^*$, where the perfect information threshold is defined as:

$$\theta^* \equiv \frac{k}{1-w} \quad (1.5)$$

Under perfect information, the model therefore predicts a sorting of firms into non-exporters and exporters similar to that of Melitz (2003). We can define productivity as the inverse of the cost per unit of quality $w + \frac{k}{\theta}$. The firms with the highest quality θ are also those with the highest productivity. Firms above the quality threshold θ^* , or equivalently below the quality-adjusted cost threshold $w + \frac{k}{\theta^*}$, are and remain exporters, while firms below the threshold never export.

1.3.5 Imperfect information: Price and profits

Under asymmetric information, suppose μ_t is the buyers' prior about the expected quality of a good from the foreign country at time t . This prior is the national reputation or "national brand", and is taken as exogenous by individual firms. We will derive its equilibrium value in the next section, as a function of the quality distribution of exports. The price offered to a firm j born at date t is either the country-wide prior, if the buyer is uninformed, or its true quality, if the buyer is informed. The probability of receiving a price which reflects the firms' true quality increases with the firm's export experience. In the first period in which firm j is active, no buyer has any information specific to the firm, so that the price only depends on the prior:

$$p_{t+1}(j) = \mu_{t+1} \quad (1.6)$$

Then in the following periods, conditional on firm j still being active, the pricing equation (1.4) implies that the price received by firm j is set according to the following rule:

$$p_{t+s}(j) = \begin{cases} \theta & \text{with probability } \rho(s-1) \\ \mu_{t+s} & \text{with probability } 1 - \rho(s-1) \end{cases} \quad \text{for } s \geq 1 \quad (1.7)$$

where $\rho(s-1)$ is the fraction of informed buyers for a firm that has previously exported $s-1$ times. In particular, a firm that exports for the first time faces only uninformed importers ($\rho(0) = 0$). As $\lim_{s \rightarrow \infty} \rho(s) = 1$, the expectation of the price converges to the perfect information price $\theta(j)$ over time if firm j stays in the market indefinitely.

Expected profits of firm j in future periods, conditional on remaining active, are the difference between its expected price and its production cost:

$$E_t^j \pi_{t+s}(j) = (\rho(s-1) - w) \theta(j) + (1 - \rho(s-1)) E_t \mu_{t+s} - k \quad (1.8)$$

Expected profits place a larger weight on true quality, and a smaller weight on national reputation, as the firm gains tenure into exporting. It immediately follows that if reputation is time-invariant, a firm with quality above the country prior ($\theta(j) > \mu$) expects to realize an increasing sequence of profits over time, while a firm with quality below the country prior ($\theta(j) < \mu$) expects decreasing profits. For all active firms, if μ is constant, the price is monotonically converging towards θ and profits are monotonically converging towards their perfect information value $(1 - w) \theta - k$.

We also assume that the updating parameter is large enough, relative to the cost of producing quality:

Assumption 2: $\rho(1) > w$

This assumption ensures that expected profits from repeat purchases – as opposed to initial purchases – are increasing in true quality.

1.4 Industry equilibrium

In this section, we define a steady-state industry equilibrium as one in which national reputation is pinned down by the average quality of a country's exports and the quality distribution is stationary. We lay out the existence conditions for high-quality and low-quality steady-state equilibria and characterize the price, entry and exit patterns in each equilibrium type.

1.4.1 Equilibrium definition

First, let us define the equation of motion for national reputation. Country reputations evolve according to the actual quality of exported goods in the previous period:

$$\mu_{t+1} = \mu_t + \eta (\bar{\theta}_t - \mu_t) \quad (1.9)$$

where $\eta < 1$ and $\bar{\theta}_t$ is the average quality of foreign firms' exports at period t . Reputation rises (respectively, falls) from one period to the next if the average quality of exported goods in the previous period was higher (respectively, lower) than expected. Setting $\eta < 1$ captures the slow-moving aspect of reputations and only matters for equilibrium stability.

Country reputations are taken as exogenous by individual firms. In each period t , let $M_t(\theta, s)$ be the number of active firms of quality θ having previously exported s times. Given an underlying quality distribution $G(\theta)$, we derive $\bar{\theta}_t$ as the average quality of exports across quality levels and cohorts of firms:

$$\bar{\theta}_t = \frac{\int_{\theta_m}^{\infty} \theta \left[\sum_{s=0}^{\infty} M_t(\theta, s) \right] d\theta}{\int_{\theta_m}^{\infty} \left[\sum_{s=0}^{\infty} M_t(\theta, s) \right] d\theta} \quad (1.10)$$

Along with μ_t , this determines μ_{t+1} according to (1.9).

In each period, a firm of quality θ having exported s times in the past stays active if the expected present value of doing so, $PV_t(\theta, s)$, is positive. The firm is free to exit at any future date. Let $T(\theta)$ be the exit date (possibly infinity) that maximizes the firm's intertemporal problem. Then $PV_t(\theta, s)$ is the discounted sum of current and future profits in (1.8) up to the optimal exit date:

$$PV_t(\theta, s) = \sum_{u=0}^{T(\theta)} \delta^u [(\rho(s+u) - w)\theta + (1 - \rho(s+u))E_t\mu_{t+u} - k] \quad (1.11)$$

Since there is no aggregate uncertainty, $E_t\mu_{t+u} = \mu_{t+u}$ for all u . There are E new firms per period, with quality draws distributed according to the pdf $g(\theta)$. A new firm of quality θ is active at $t+1$ if $PV_{t+1}(\theta, 0) > 0$. Hence the number of active new firms per quality level is:

$$M_{t+1}(\theta, 0) = \begin{cases} Eg(\theta) & \text{if } PV_{t+1}(\theta, 0) > 0 \\ 0 & \text{if } PV_{t+1}(\theta, 0) \leq 0 \end{cases} \quad (1.12)$$

Among incumbent firms of quality θ having exported s times, $\delta M_t(\theta, s-1)$ survive from period t to period $t+1$. They remain active if $PV_{t+1}(\theta, s) > 0$ in equation (1.11). Thus the number of active old firms is, for $s \geq 1$:

$$M_{t+1}(\theta, s) = \begin{cases} \delta M_t(\theta, s-1) & \text{if } PV_{t+1}(\theta, s) > 0 \\ 0 & \text{if } PV_{t+1}(\theta, s) \leq 0 \end{cases} \quad (1.13)$$

Equations (1.9), (1.10), (1.12) and (1.13) determine $\bar{\theta}_{t+1}$ and μ_{t+2} . We can then define the industry steady-state as an equilibrium with constant reputation and a constant distribution of quality.

Definition 1.1 $\left\{ \mu, \{M(\theta, s)\}_{s, \theta} \right\}$ is a steady-state equilibrium if and only if:

- (i) For all $\theta \in [\theta_m, \infty)$ and all $s \geq 0$, if $M_t(\theta, s) = M(\theta, s)$ and $E_t \mu_{t+u} = \mu$ for all $u \geq 0$, then $M_{t+1}(\theta, s) = M(\theta, s)$ in (1.12) and (1.13);
- (ii) If $M_t(\theta, s) = M(\theta, s)$ for all $\theta \in [\theta_m, \infty)$ and all $s \geq 0$, then $\bar{\theta}_t = \mu$ in (1.10).

Condition (i) ensures that the number of firms in each quality-age segment is constant in the steady state. Condition (ii) states that the average quality that results from an equilibrium distribution of active firms is equal to the equilibrium country reputation; it guarantees that μ is constant in a steady state. In other words, a steady-state with national reputation μ is a rational expectations equilibrium if the average quality of active exporters is equal to buyers' quality expectation. The endogenous entry and exit decisions induced by μ justify the reputation ex post.

From this point on, we assume that the quality draw of entrants has a Pareto distribution with support on $[\theta_m, \infty)$ and shape parameter $\alpha > 1$:

$$G(\theta) \equiv 1 - \left(\frac{\theta_m}{\theta} \right)^\alpha \quad (1.14)$$

and note μ_0 the unconditional expectation of quality draws: $\mu_0 \equiv \frac{\alpha}{\alpha-1} \theta_m$.

1.4.2 High quality equilibrium

We call “high-quality equilibrium” (HQE) a steady-state equilibrium where the country reputation μ exceeds the perfect information quality threshold θ^* .

Definition 1.2 $\left\{ \mu, \{M(\theta, s)\}_{s, \theta} \right\}$ is a high-quality steady-state equilibrium if $\mu > \theta^*$ and $\left\{ \mu, \{M(\theta, s)\}_{s, \theta} \right\}$ is a steady-state equilibrium according to Definition 1.1.

First, we characterize firms' entry and exit decisions in a high-quality equilibrium given μ . We then proceed to derive the existence conditions for a HQE.

Entry and exit

In a HQE, national reputation is high and time-invariant, i.e. $\mu_t = \mu > \theta^*$ for all t . Therefore, a firm with quality equal to the country's reputation would be viable in a perfect information setting. All firms receive high prices as they enter the export market, which encourages entry. Formally, we can prove the following.

Lemma 1.1 *In a HQE with country reputation $\mu > \theta^*$,*

- (i) *All entrants are initially active;*
- (ii) *Firms with $\theta < \theta^*$ expect to exit after a number of periods $T(\theta)$ weakly increasing in quality θ ;*
- (iii) *Firms with $\theta > \theta^*$ stay in the market until hit by the exogenous shock.*

Proof: see Appendix A.1.

The sorting of firms according to their quality parameter is represented in Figure 1.1. Low-quality firms below θ^* find it profitable to enter initially as they have low production costs, and can therefore reap positive profits as long as buyers do not have information about their type. The higher the country reputation, the higher the price they receive in the first period. As first-period profits are decreasing in quality, low- θ firms always find it profitable to enter the market as fly-by-nights. However, given the expected profit equation (1.8) and Assumption 2, profits from

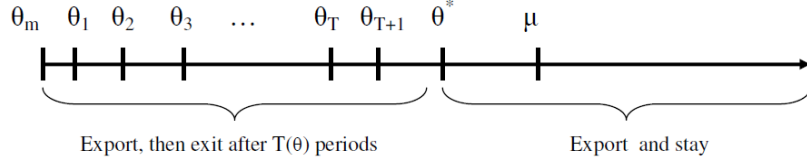


Figure 1.1: **Sorting of firms by θ with high national reputation**

repeat purchases are increasing in quality and converging over time towards their perfect information value. Hence, all firms below θ^* , which would not survive under perfect information, face a decreasing sequence of profits converging to a negative value. They will eventually see their expected present value of profits turn negative and exit. The number of periods $T(\theta)$ that a firm with quality $\theta < \theta^*$ stays active is pinned down by the condition that its expected profit is positive for the first $T(\theta)$ periods it exports, and negative in all following periods.

Let us define θ_T as the highest quality type that exits after selling for T periods – or the lowest quality type that exits after selling for $T + 1$ periods:

$$\theta_T = \max \left\{ \frac{k - (1 - \rho(T))\mu}{\rho(T) - w}, \theta_m \right\} \quad \text{for } T \geq 1 \quad (1.15)$$

and $\lim_{T \rightarrow \infty} \theta_T = \theta^*$.

For high-quality firms above θ^* , it is always profitable to enter and keep exporting. Firms between θ^* and μ have expected profits declining over time, but positive in every period. Firms above μ have expected profits increasing over time. The highest quality firms incur losses in the initial period, but recoup these losses in later periods once enough buyers have received information about their type. Their expected intertemporal profits are always positive. Thus, firms above θ^* never exit before they are forced to by the exogenous shock, as their per-period profits are converging towards the strictly positive perfect information level.

Average quality

In a steady state indexed by $\mu > \theta^*$, the number $M(\theta, s)$ of active firms of quality θ having already exported s times is derived from Lemma 1.1 and equations (1.12) and (1.13):

$$M(\theta, s) = \begin{cases} \delta^s E g(\theta) & \text{if } \theta < \theta^* \text{ and } s < T(\theta) \\ 0 & \text{if } \theta < \theta^* \text{ and } s \geq T(\theta) \\ \delta^s E g(\theta) & \text{if } \theta \geq \theta^* \end{cases} \quad (1.16)$$

so that the total number of active firms of quality θ is $\frac{1-\delta^{T(\theta)}}{1-\delta} E g(\theta)$ if $\theta < \theta^*$, and $\frac{1}{1-\delta} E g(\theta)$ if $\theta \geq \theta^*$. Using (1.10) and (1.14), we derive the steady-state average quality of exports in a HQE as a function of μ and exogenous parameters:

$$\bar{\theta}(\mu) = \mu_0 \left(\frac{1 - \sum_{T=0}^{\infty} \delta^{T+1} \left[\left(\frac{\theta_m}{\theta_T} \right)^{\alpha-1} - \left(\frac{\theta_m}{\theta_{T+1}} \right)^{\alpha-1} \right]}{1 - \sum_{T=0}^{\infty} \delta^{T+1} \left[\left(\frac{\theta_m}{\theta_{T+1}} \right)^{\alpha} - \left(\frac{\theta_m}{\theta_{T+1}} \right)^{\alpha} \right]} \right) \quad (1.17)$$

where $\theta_0 \equiv \theta_m$ and θ_T, θ_{T+1} are defined by (1.15). The average quality of active firms is higher than the mean of the unconditional distribution of θ , as lower-quality firms exit earlier than high-quality firms. However, it lies below the perfect information average export quality.

Existence conditions

There exists a HQE if there is a fixed point of $\bar{\theta}(\mu)$ in equation (1.17) such that $\mu = \bar{\theta}(\mu) > \theta^*$. Proposition 1.1 establishes existence conditions.

Proposition 1.1 *There is a unique HQE if and only if $\bar{\theta}(\theta^*) > \theta^*$, or equivalently if and*

only if

$$\alpha \left(\frac{\theta_m}{\theta^*} \right) + \frac{\delta}{1-\delta} \left(\frac{\theta_m}{\theta^*} \right)^\alpha > \alpha - 1 \quad (1.18)$$

Proof: see Appendix A.1.

An equilibrium steady-state reputation is a reputation μ such that $\bar{\theta}(\mu) = \mu$. The intuition of the proof is as follows. Starting from a reputation above θ^* , raising μ has a negative effect on actual quality. Improving national reputation, for a given distribution of θ draws, does not affect the decisions of firms above θ^* to stay or exit, as they are already remaining active as long as possible. However, it encourages lower-quality firms to stay longer: for firms below θ^* , a higher μ raises all $T(\theta)$, implying that low-quality firms wait longer before exiting the market. In short, the incentives of high-quality firms are not affected but those of low-quality firms result in a higher export duration of firms producing “bad” varieties. Hence, the average quality of exported goods falls when μ increases. It follows that $\bar{\theta}(\mu)$ is strictly decreasing on $[\theta^*, \infty)$ and therefore if $\bar{\theta}(\theta^*) > \theta^*$, there is a unique fixed point of $\bar{\theta}(\mu)$ in the high quality region. This fixed point is the unique HQE.

The HQE existence condition (1.18) holds for δ high enough, α low enough, and/or w and k low enough. A high δ implies that exogenous exit is relatively less prevalent than endogenous exit, increasing the relative mass of high-quality firms. A low α means that there is high dispersion in the prior distribution of θ , and therefore more firms at the right tail of the distribution pushing up the mean. A low w reduces the relative cost advantage of low-quality firms, as well as the loss incurred in initial periods by high-quality firms. Lower w and k also lower the perfect information threshold θ^* , making it more likely that the economy ends up in a high-quality equilibrium.

1.4.3 Low quality equilibrium

We call “low-quality equilibrium” (LQE) a steady-state equilibrium where the country reputation falls short of the perfect information quality threshold θ^* .

Definition 1.3 $\left\{ \mu, \{M(\theta, s)\}_{s, \theta} \right\}$ is a low-quality steady-state equilibrium if $\mu < \theta^*$ and $\left\{ \mu, \{M(\theta, s)\}_{s, \theta} \right\}$ is a steady-state equilibrium according to Definition 1.1.

As in the high-quality case, we first determine the entry and exit patterns given μ and then derive existence conditions.

Entry and exit

In a LQE, national reputation is low and constant, i.e. $\mu_t = \mu < \theta^*$ for all t . A firm with quality μ would never export in a perfect information setting. Under asymmetric information, we can show the following:

Lemma 1.2 In a LQE with country reputation $k + w\theta_m < \mu < \theta^*$,

(i) Firms with quality $\theta < \theta_L$ enter the export market and exit after selling for one period, where

$$\theta_L \equiv \frac{\mu - k}{w} < \mu < \theta^* \quad (1.19)$$

(ii) Firms with quality $\theta > \theta_H$ enter and stay in the market until hit by the exogenous shock, where

$$\theta_H \equiv \frac{k - \mu(1 - A_\rho)}{A_\rho - w} > \theta^* \quad (1.20)$$

and $A_\rho \equiv (1 - \delta) \sum_{s=0}^{\infty} \delta^s \rho(s)$.

(iii) Firms with quality $\theta_L \leq \theta \leq \theta_H$ never enter the market.

Proof: see Appendix A.1.

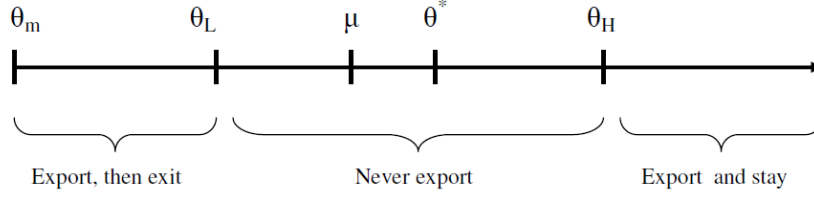


Figure 1.2: **Sorting of firms by θ with low national reputation**

Figure 1.2 shows the sorting of firms by quality into “fly-by-nights”, non-exporters and continuous exporters. Fly-by-night firms exist as long as $\mu > k + w\theta_m$, which ensures that some low-quality firms realize positive first-period profits. These firms would not survive under perfect information, but gain from the information asymmetry. However, given $\mu < \theta^*$ and Assumption 2, they would make losses if they were to stay active in the second period, after buyers have received a firm-specific signal. Firms below θ_L therefore exit immediately after selling once.

All firms with better quality than the country reputation μ are not profitable in the first period when they enter export markets. Above θ_H , the present value of expected profits is positive: expected profits from sales in later periods, when a larger portion of the price reflects true quality, exceed initial losses. The negative profits in their first periods of existence can be interpreted as investments in building a brand name or firm-specific reputation, distinct from the country reputation.

An intermediate range of firms $[\theta_L, \theta_H]$ around θ^* never become active exporters. Those with $\theta_L < \theta < \theta^*$ have negative expected profits at all periods, while those with $\theta^* < \theta < \theta_H$ would be profitable in the long run once enough buyers have gathered information about their type. However, for the latter, the present value of their profit stream is negative: losses incurred in the initial periods in order to establish a reputation are not made up for with later profits. Hence this range of firms is kept out of export markets by the information asymmetry and the cost of

revealing quality.

Lastly if $\mu < k + w\theta_m$, then there are no active firms below θ^* , given that national reputation is too low for any firm to realize positive first-period profits. This results in a high average quality of exported goods. Therefore, there cannot be an equilibrium with endogenous reputation in this region.

Average quality

In a steady state indexed by $\mu < \theta^*$, the number $M(\theta, s)$ of active firms of quality θ having already exported s times is derived from Lemma 1.2 and equations (1.12) and (1.13):

$$M(\theta, s) = \begin{cases} Eg(\theta) & \text{if } \theta < \theta_L \text{ and } s = 0 \\ 0 & \text{if } \theta < \theta_L \text{ and } s \geq 1 \\ 0 & \text{if } \theta_L \leq \theta \leq \theta_H \\ \delta^s Eg(\theta) & \text{if } \theta > \theta_H \end{cases} \quad (1.21)$$

so that the number of active firms of quality θ is $Eg(\theta)$ if $\theta < \theta_L$ and $\frac{1}{1-\delta}Eg(\theta)$ if $\theta > \theta_H$. Using (1.10) and (1.14), we derive the steady-state average quality of exports in a LQE as a function of μ and the economy's exogenous parameters:

$$\bar{\theta}(\mu) = \mu_0 \left(\frac{1 - \left(\frac{\theta_m}{\theta_L}\right)^{\alpha-1} + \frac{1}{1-\delta} \left(\frac{\theta_m}{\theta_H}\right)^{\alpha-1}}{1 - \left(\frac{\theta_m}{\theta_L}\right)^{\alpha} + \frac{1}{1-\delta} \left(\frac{\theta_m}{\theta_H}\right)^{\alpha}} \right) \quad (1.22)$$

where θ_L, θ_H are defined respectively by (1.19) and (1.20). The volume of sales and average quality are lower than in high-reputation equilibria, due both to the existence of a gap in the distribution of active exporters, and to the fact that low-quality firms exit after selling for one period only.

Existence conditions

The industry has at least one LQE if there exists a fixed point of $\bar{\theta}(\mu)$ in equation (1.22) such that $\mu = \bar{\theta}(\mu) < \theta^*$. Specifically:

Proposition 1.2 *If $\bar{\theta}(\theta^*) < \theta^*$, there exists at least one LQE.*

Proof: see Appendix A.1.

In other words, if condition (1.18) does not hold, there is an odd number of LQE and no HQE. The lowest possible level of national reputation ($\mu = \theta_m$) results in the highest average quality, as it drives out all low quality firms and some high quality firms. Hence $\bar{\theta}(\theta_m) > \theta_m$ and if $\bar{\theta}(\theta^*) < \theta^*$, there must be at least one fixed point in (θ_m, θ^*) . However, the equilibrium may not be unique, since $\bar{\theta}(\mu)$ is not monotonic over the interval. In the low reputation region, increasing μ has two consequences with opposite effects on average quality. First, it enables more firms to realize positive profits from first-period sales (higher θ_L). This fosters entry by firms with below-average quality, given that $\theta_L < \mu$ in a LQE; and it lowers the expected quality of active firms. Second, increasing μ reduces the loss incurred by high-quality firms before they have been able to signal their quality to buyers, allowing more firms with above-average quality to be active (lower θ_H). The net change in $\bar{\theta}$ depends on the balance between these two effects. As long as the economy remains in the low reputation region ($\mu < \theta^*$), there is no effect of a better reputation on the exit rates of exporters: all active firms below θ^* sell for one period only, while all active firms above θ^* stay as long as they are able to.

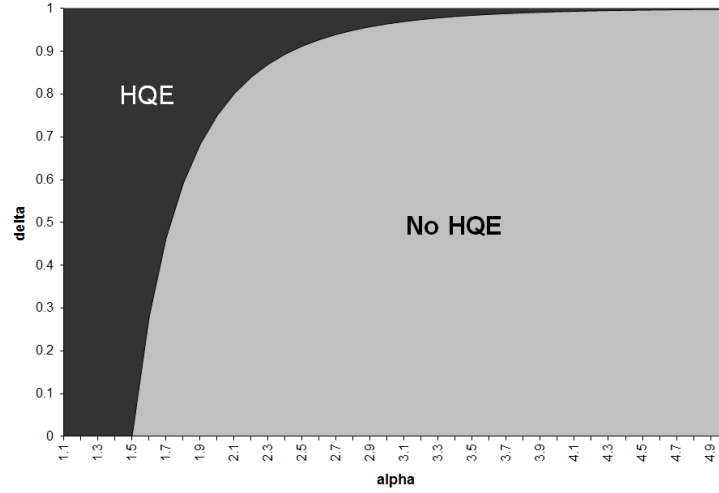


Figure 1.3: **Parameter values for HQE and LQE** ($\theta_m = 1, k = 1.5, w = 0.5$)

1.4.4 Summary: Industry steady-states

To sum up, depending on parameters, the rational expectations steady-state falls into one of two categories. The type of equilibrium will depend on whether the (not necessarily unique) fixed point of $\bar{\theta}(\mu)$ falls left or right of θ^* . In a “high-quality equilibrium”, all firms produce and sell for at least one period, firms above θ^* remain active until they are exogenously forced to exit, and firms below θ^* exit in finite time after a number of periods increasing in θ . In a “low-quality equilibrium”, there is a gap around θ^* where firms are never active. Below θ_L , they exit after exporting for a single period; above θ_H , they only exit exogenously.

In general, we cannot rule out multiple equilibria. If $\bar{\theta}(\theta^*) < \theta^*$, there are an odd number of LQEs. If $\bar{\theta}(\theta^*) > \theta^*$, there is one HQE and there are either zero or an even number of LQEs²². These multiple equilibria give rise to the possibility of self-fulfilling reputation shocks, examined in section 1.5.

²² A graphical example of multiple equilibria is shown in Figure 1.7.

Figure 1.3 illustrates the existence condition (1.18). In the dark region, the condition holds and a unique HQE exists. This is true for low enough α and high enough δ . In the light grey region, there is no HQE; the steady-state of the economy is necessarily a LQE. A higher k or w shifts the border to the left and expands the no HQE region. Conversely, lowering k or w widens the HQE region.

1.4.5 Additional predictions: Unit prices and hazard rates

The model yields additional predictions on the patterns of price and exit rates. Although these results are not the main focus of our paper, their consistency with existing empirical evidence lends support to our theory. First, we characterize the path of prices for a given cohort of firms.

Result 1.1 Unit prices. *In a steady-state low-quality equilibrium, the average unit price charged at $t + s$ by firms born at date t is strictly increasing in s . In a steady-state high-quality equilibrium, the average unit price charged at $t + s$ by firms born at date t is strictly increasing in s for all s if $\mu > \frac{\alpha}{\alpha-1}\theta_1$ and for $s \geq T(\frac{\alpha-1}{\alpha}\mu)$ otherwise.*

Proof: See Appendix A.1.

At the firm level, there is a brand premium for high-quality firms both in a HQE and in a LQE: the price charged increases over time for a given good provided that its quality is better than the country average. Result 1.1 establishes that on average, incumbents receive higher prices than entrants, and the average price among a cohort of firms is higher, the longer the cohort has been active on export markets. This result follows from the fact that over time, an increasing fraction of prices reflect firms' true quality parameters, and the average quality of a cohort of firms weakly increases over time as the lowest quality firms exit.

Interestingly, these predictions are supported by the findings of Foster, Haltiwanger, and Syverson (2008) on the behavior of US firms in their domestic market. They show that entering businesses have significantly lower prices than incumbents, and prices rise with plant age.

Second, our model implies that firms' exit rates vary systematically with their quality and across cohorts.

Result 1.2 Hazard rate. *In a steady-state equilibrium, the aggregate hazard rate is weakly decreasing in quality and in firms' export experience.*

Proof: See Appendix A.1.

The first part of Result 1.2 establishes that across cohorts, the fraction of active firms that exit per period is higher for lower-quality firms, both in a LQE and in a HQE. Low-quality firms exit voluntarily in finite time while high-quality firms only exit when hit by the exogenous death shock. The second part states that the probability of exit, across quality levels, decreases with the age of a cohort. It derives from the fact that the distribution of quality among older cohorts has a higher lower bound than among younger cohorts.

This last prediction is consistent with the findings of Besedes and Prusa (2004) on survival rates in US import relationships at the disaggregated product level. They estimate that the probability that the import relationship will end falls with its duration for differentiated products. We confirm these results in our product level data: within HS-2 manufacturing industries, the average hazard rate of HS-10 products drops from 31% in the first year the country exports the good to 8% after 10 years (see Appendix A.4 for details).

1.5 Policy implications

How can countries improve their “national brand name” – and is it worth it? First-best policies would involve conducting verifiable quality audits, or taxing low-quality firms and subsidizing high-quality ones. These policies are not feasible when policy-makers are not better informed than consumers about firms’ quality levels. Here, we look at the effects of two main policy instruments on reputation, quality and welfare: export subsidies, and export promotion campaigns creating reputation shocks.

1.5.1 Export subsidy

Consider a permanent²³ unanticipated subsidy to fixed export costs, resulting in a lower effective k for active exporters, financed by non-distortionary lump sum taxes. Since there are no domestic consumers in our model, welfare considerations abstract from changes in consumer surplus. We will compare the effect of the subsidy on aggregate industry profits and its direct cost in the steady-states before and after the subsidy.

Starting from a LQE

In a LQE, a decrease in k induces more high-quality firms to start and continue exporting (lower θ_H) and more low-quality firms to export for one period (higher θ_L). We prove that the overall effect on average quality, and thus steady-state national reputation, is positive with Pareto-distributed quality draws and δ not too low: starting from a LQE, an export subsidy increases long-run equilibrium quality.

²³ We are comparing the long-run industry equilibria with and without the policy. With a temporary subsidy, if the equilibrium is unique, the economy would return to the initial steady-state in the long-run after the subsidy expires.

Proposition 1.3 *An export subsidy in a LQE increases the steady-state average quality and welfare of the exporting country.*

Proof: see Appendix A.1.

The welfare result is a consequence of the higher long-run reputation. The entry response to the subsidy creates a positive externality on firms that would be exporting regardless of the policy. They receive higher prices on their exports due to improved reputation. This externality lies at the core of the beneficial effect of an export subsidy for a country that is in a low equilibrium. New exporters also benefit from the better reputation as well as the subsidy, so that the increase in aggregate profits exceeds the tax cost of the subsidy. Hence, our model provides a new justification for export subsidies in countries exporting goods at the low end of the quality ladder²⁴.

Figure 1.4 provides a numerical example of the economy's transition to its new, higher steady state in a case where the LQE is unique. It shows the transition dynamics for average quality, reputation, the thresholds θ_L and θ_H , as well as the number of active firms and aggregate profits following an unanticipated permanent decline in k , and assuming that all firms correctly anticipate the future path of μ . In the first period in which the subsidy is introduced, reputation is unchanged but the lower cost makes entry profitable for a larger range of firms. The gap (θ_L, θ_H) immediately narrows. The immediate net effect is a decline in average quality as the entry of low-quality firms dominates on impact for an unanticipated subsidy. However, over time as new cohorts of high-quality firms enter and decide to stay active, average quality $\bar{\theta}$ and reputation μ start rising, while θ_L further increases and θ_H keeps falling. μ adjusts to $\bar{\theta}$ with a lag, further encouraging entry and pushing up $\bar{\theta}$. This continues

²⁴ In a setting where firms would set prices in a competitive way, we would have to balance this gain against the argument that an export subsidy tends to subsidize foreign consumers.

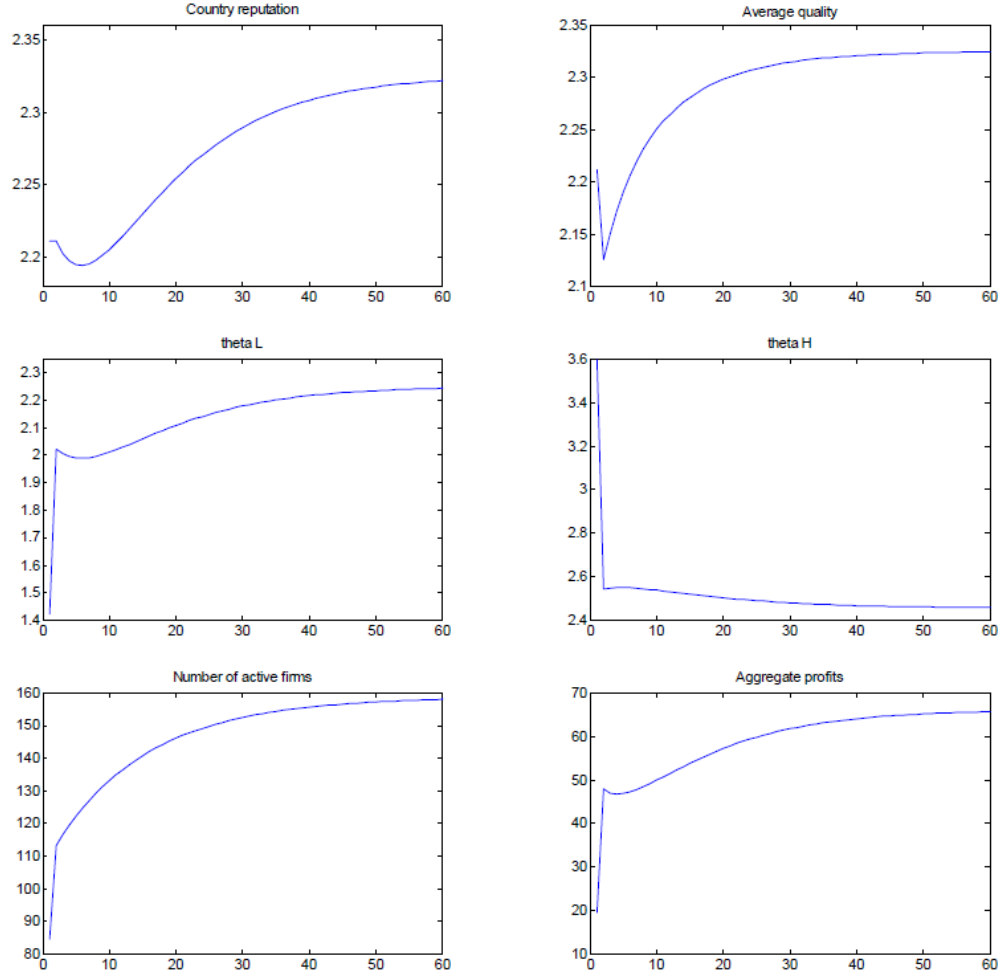


Figure 1.4: **Export subsidy in a LQE.** Parameter values: $\theta_m = 1$, $\alpha = 3$, $\delta = 0.9$, $\eta = 0.1$, $E = 100$, $k = 1.5$, $k_{subs} = 1.2$. $\theta^* = 3$. The initial unique steady-state of this economy is a LQE with $\mu = \bar{\theta} \approx 2.211$.

until reputation has caught up with actual quality and the economy has reached its new steady state.

Starting from a HQE

We have shown that an export subsidy enhances welfare in low-reputation exporting countries. Can the same policy be beneficial for a country that already exports high-quality goods? The next proposition states that instead of allowing a high-reputation country to move further up the quality ladder, a subsidy is actually detrimental to average quality and welfare in a high-quality equilibrium.

Proposition 1.4 *An export subsidy in a HQE lowers the steady-state average quality of exports and welfare of the exporting country.*

Proof: see Appendix A.1.

This result hinges on the changed exit patterns of high-quality versus low-quality firms. A decrease in k lowers θ^* and induces low-quality firms to stay longer. It does not change the incentives and decisions of high-quality firms. Hence, since average quality is initially above θ^* , the subsidy lowers actual mean quality: the number of low-quality firms increases while the number of high-quality firms remains unchanged.

This lower average quality, in turn, damages the country's reputation, which adjusts slowly to observed average quality. It has a negative effect on the profits of all active firms, all the more so as they have been active for a shorter time. Hence, the entry of lower-quality firms induced by the subsidy exerts a negative externality on all other active firms, through its effect on national reputation. This externality explains why the overall increase in aggregate profits of all firms receiving the subsidy is not large enough to cover the cost of the policy, despite a higher volume of sales.

Intuitively, we can decompose the welfare effect into two components, respectively the effect on the intensive and extensive margin of profits. For the combination of quality and export experience for which firms are active both with and without the subsidy, the effect is unambiguously negative: they receive lower prices, and the additional profits brought about by the subsidy are taken out of taxes. For the additional periods in which firms below θ^* stay in the market because of the subsidy, their profits fall short of the cost of the subsidy: otherwise, since the price is lower than in the absence of the policy, they would have been exporting without the subsidy. Therefore, the net effect is unambiguously negative.

Figure 1.5 shows an illustration of the transition to the new steady-state. When the policy is introduced, low-quality firms immediately stay longer, leading to an increase in the number of active firms and a steep decline in average quality. National reputation then starts adjusting downwards until it reaches its new steady-state level. Aggregate profits first rise above their long-term value, because reputation remains “too high” during the adjustment period. Over time as μ falls and new cohorts of firms respond to the lower cost, the economy converges to a steady-state with lower reputation and quality. As subsidies reduce firms’ costs, aggregate profits are higher than in the initial equilibrium; but the increase in profits does not match the cost of the subsidy.

In a nutshell, in a HQE, a subsidy to the fixed cost k actually lowers average quality by promoting entry of low-quality firms. Overall, the desirability of an export subsidy depends on the tradeoff between encouraging entry by high-quality firms which are deterred by the cost of establishing a reputation, and inducing entry by low-quality fly-by-nights.

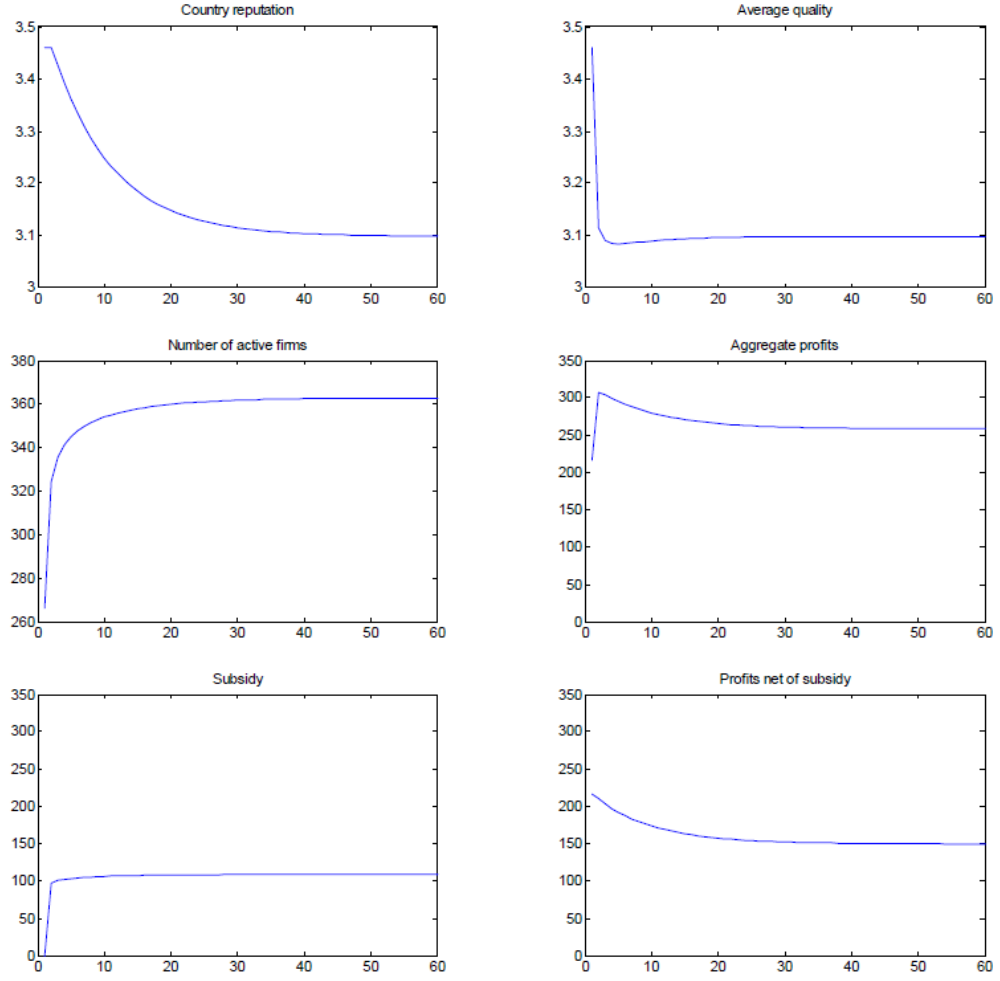


Figure 1.5: **Export subsidy in a HQE.** Parameter values: $\theta_m = 1$, $\alpha = 2$, $\delta = 0.9$, $\eta = 0.1$, $E = 100$, $k = 1.5$, $k_{subs} = 1.2$. $\theta^* = 3$. The initial unique steady-state of this economy is a HQE with $\mu = \bar{\theta} \approx 3.461$.

1.5.2 Export promotion campaign and reputation shocks

An export promotion campaign is an effort to promote the quality of foreign goods in Home, e.g. through advertisements by export promotion agencies or exporters' associations, or by hosting "mega-events" to showcase the country – as we mentioned, the Olympics in Seoul in 1988 and in Beijing in 2008 were explicitly assigned this goal by government officials. We model it as a one-shot increase in the national image μ_t from the initial steady-state, absent any changes in the underlying quality distribution of firms. More generally, the analysis below applies to reputation shocks not driven by changes in the quality distribution. We focus on situations in which the economy is initially in a stable low-quality equilibrium.

Unique steady-state

If the economy has only one long-run equilibrium, it must return to this steady-state in the long run. The export promotion campaign only has short-run effects on the distribution of quality. Figure 1.6 provides an example of the transition dynamics associated with a positive shock. An export promotion campaign results in a one-shot increase in national reputation μ_t , starting from the steady-state.

The initial jump in reputation fosters entry by firms in segments of the quality distribution where they were previously inactive: θ_H decreases and θ_L increases. The net effect of the entry response is a drop in average quality $\bar{\theta}$ immediately after the shock occurs. Thus, the gap between actual and perceived average quality leads national reputation to adjust downwards in the following periods. As the country's reputation moves back down, the range of qualities for which entrants choose to stay inactive widens again, driving average quality back up until it has reverted to its original steady-state value, along with reputation. There are no long-run effects.

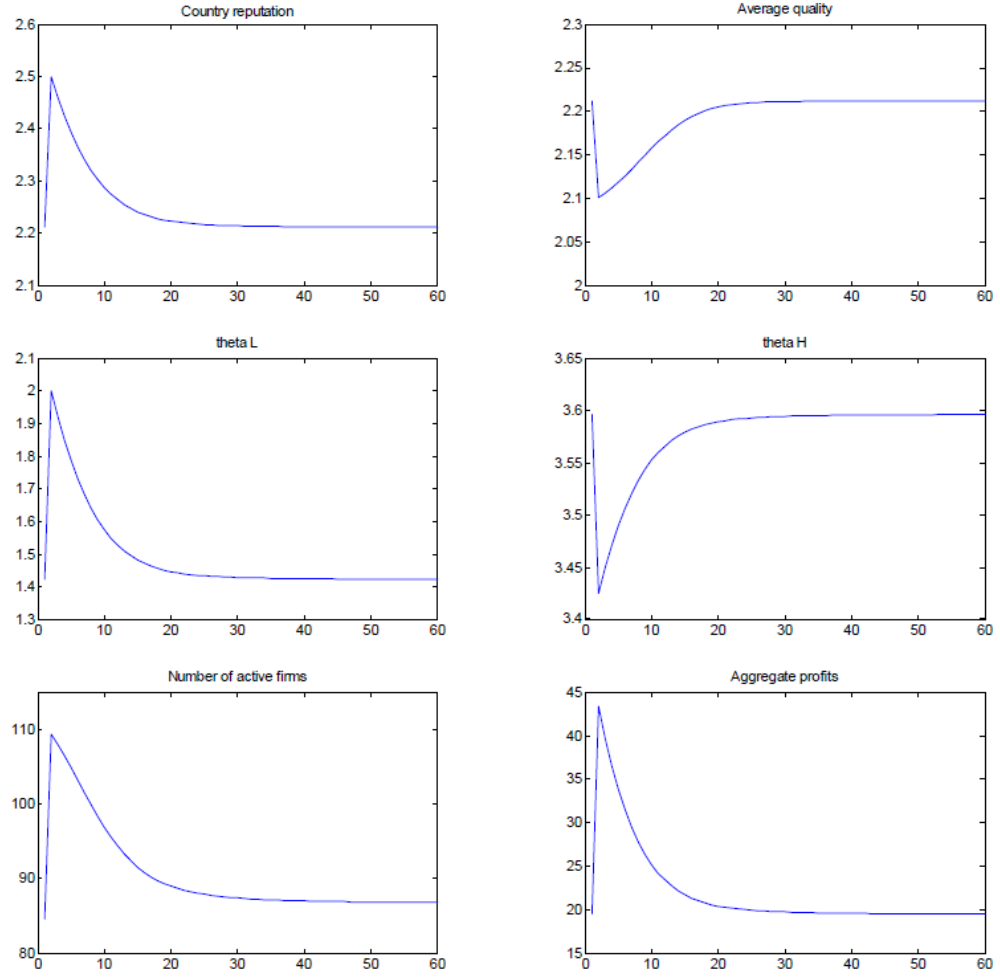


Figure 1.6: **Positive reputation shock with a unique LQE.** Parameter values identical to Figure 1.4. μ_t rises exogenously to 2.5 at $t = 1$.

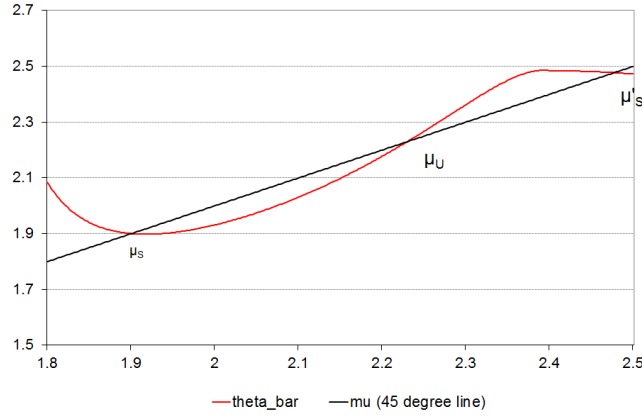


Figure 1.7: **Multiple equilibria.** Parameter values: $\theta_m = 1$, $\alpha = 2.2$, $\delta = 0.7$, $\eta = 0.1$, $E = 100$, $k = 1.2$. $\theta^* = 2.4$. The steady-states of this economy are $\mu_S \approx 1.900$, $\mu_U \approx 2.230$ and $\mu'_S \approx 2.477$

Multiple steady-states

If the economy has multiple steady-states, there are several low-quality equilibria. Figure 1.7 provides an illustration of this case. Assume the country starts in a stable LQE μ_S . If there are no steady-states with higher reputation than μ_S , an export promotion campaign has the same effects as when the steady-state is unique.

If there exists a steady-state $\mu > \mu_S$, there must be an even number of steady-states with $\mu > \mu_S$. Let us define $\mu_U > \mu_S$ such that μ_U is a steady-state and for all $\mu_S < \mu < \mu_U$, μ is not a steady-state. Similarly define $\mu'_S > \mu_U$ such that μ'_S is a steady-state and for all $\mu_U < \mu < \mu'_S$, μ is not a steady-state. μ_U is unstable and μ'_S is stable.

Starting in μ_S , a “small” promotion campaign moves national reputation to a level μ_t such that $\mu_S < \mu_t < \mu_U$. The impact of a small campaign is similar to the case with a unique equilibrium: in the long run, the economy returns to μ_S . A “large” promotion campaign moves national reputation to $\mu_t > \mu_U$. Then, the resulting entry by firms below the initial θ_H and above the initial θ_L leads to an increase in

average quality, magnifying the shock. Actual quality follows reputation in a self-fulfilling manner. Quality and reputation keep rising until the economy settles in the more favorable steady-state μ'_S . In the example of Figure 1.7, μ'_S is a high-quality equilibrium. These results are summarized in Proposition 1.5.

Proposition 1.5 *Positive reputation shocks*

(i) *Starting from a unique LQE or from a LQE that has the highest μ among steady-states, a one-time positive shock to national reputation μ_t increases aggregate profits and decreases average quality in the short-run, and has no effect in the long-run.*

(ii) *Starting from a stable LQE μ_S such that there exist other steady-states above μ_S , a small one-time positive shock ($\mu_t < \mu_U$ as defined above) to national reputation increases aggregate profits and may increase or decrease average quality in the short-run, and has no effect in the long-run.*

(iii) *Starting from a stable LQE μ_S such that there exist other steady-states above μ_S , a large one-time positive shock ($\mu_t > \mu_U$ as defined above) to national reputation increases aggregate profits and average quality both in the short-run and in the long-run.*

Proof: see Appendix A.1.

Figure 1.8 illustrates the transition to the new steady-state. With the parameter values of Figure 1.7, the economy starts in the LQE μ_S and the unanticipated one-shot policy at time 1 results in a jump of the country reputation above μ_U . Following the large shock, the economy moves to the HQE μ'_S . Note that the policy is not anticipated prior to time 1, but once the shock is realized, we assume that all firms have correct expectations of the subsequent path of μ . The immediate effect of the shock is to boost expected profits for all firms, fostering entry by a range of firms that did not export in the initial steady-state. For a large shock as defined in Proposition

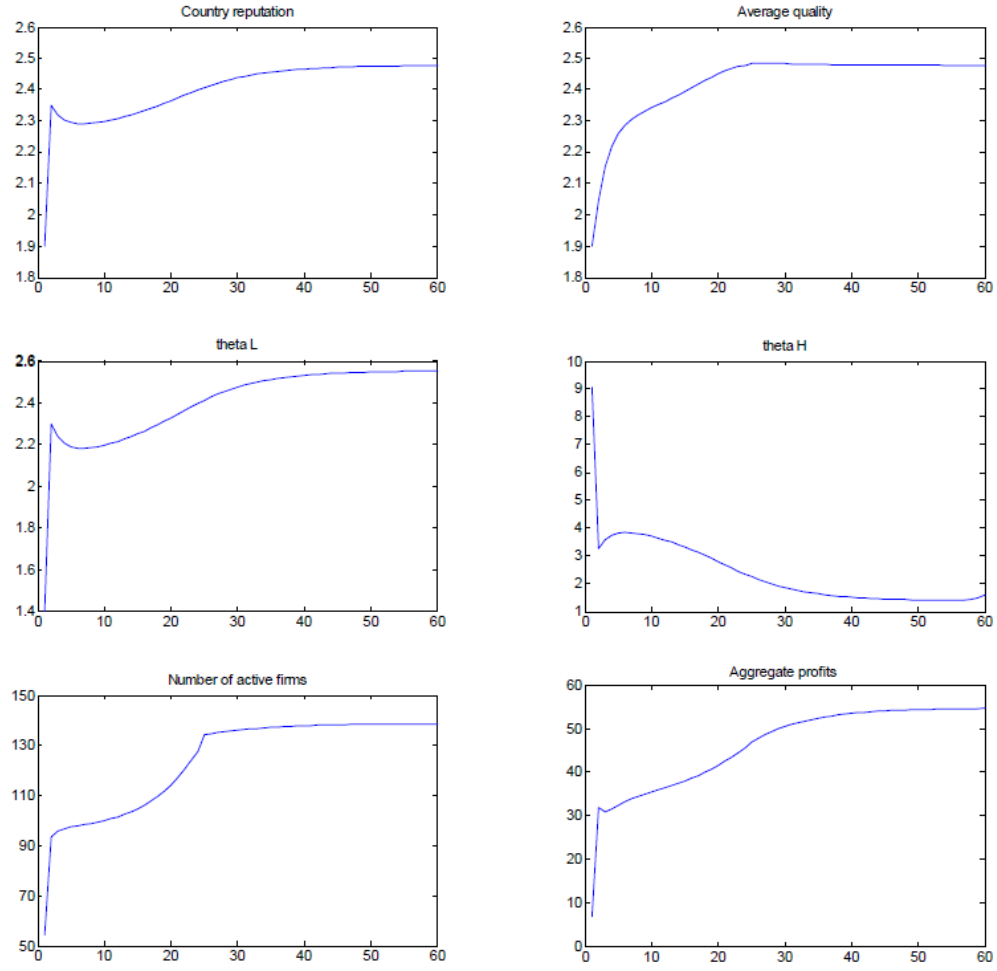


Figure 1.8: **Large positive reputation shock with multiple equilibria.** Parameter values identical to Figure 1.7. μ_t rises exogenously to 2.35 at $t = 1$.

1.5, the net effect of additional entry around θ_L and θ_H is to raise average quality, sufficiently so to ensure that reputation in the next period remains above μ_U . As the policy was not anticipated by high-quality firms in the previous periods, μ falls in the immediate aftermath of the shock. Reputation rises thereafter as new cohorts of high-quality firms decide to enter and stay active, until the economy settles in the new steady-state μ'_S with higher quality and higher aggregate profits.

To sum up, a policy which brings about a positive shock to national reputation has only short-lived effects on the quality distribution of exporters and on aggregate profits in a unique steady-state or if the shock is small. However, a large shock starting from a low-reputation, low-quality equilibrium is self-fulfilling when the economy has multiple steady states. It encourages entry by high-quality firms. In the portions of the average quality-reputation function where entry by high-quality firms drives up quality more than entry by lower-quality firms drives it down, a one-shot increase in reputation brings about a permanent increase in quality, profits and welfare. To be successful in the long-run, an export promotion campaign based solely on improving the country's brand image must therefore induce a large jump in beliefs. A negative reputation shock has the opposite effects, as stated in Corollary 1.1.

Corollary 1.1 *Negative reputation shocks*

(i) *Starting from a unique LQE or from a LQE that has the lowest μ among steady-states, a one-time negative shock to national reputation μ_t reduces aggregate profits and increases average quality in the short-run, and has no effect in the long-run.*

(ii) *Starting from a stable LQE μ'_S such that there exist other steady-states below μ'_S , a small one-time negative shock ($\mu_t > \mu_U$ as defined above) to national reputation reduces aggregate profits and may increase or decrease average quality in the short-run, and has no*

effect in the long-run.

(iii) Starting from a stable LQE μ'_S such that there exists other steady-states below μ'_S , a large one-time negative shock ($\mu_t < \mu_U$ as defined above) to national reputation reduces aggregate profits and average quality both in the short-run and in the long-run.

This last result implies that there can be long-term consequences of a sudden large drop in reputation, which moves a country to a less desirable steady-state equilibrium. In particular, large product recalls or heavily mediatized consumer safety scandals concerning exports of one country can permanently affect the structure of its industry²⁵, lowering both quality and reputation in the long-run.

1.6 Conclusion

We have shown that when consumers are not fully informed about the quality of what they buy, national reputation matters for exporters. For new firms without established brand names, the inability to reveal quality to consumers before purchase distorts the incentives to enter export markets. Low-quality firms rely on the national brand, while high-quality firms suffer from it. This framework helps explain the high observed turnover rate among new exporters, and a “brand premium” whereby incumbents receive higher unit prices than entrants.

More broadly, unobservable quality tilts the long-run quality composition of an export-oriented industry towards its low end, all the more so as the exporting econ-

²⁵ Chisik (2003) provides an example of such a negative reputation shock in the Colombian garment industry: “Although expanding at a rapid rate throughout the early 1970s Colombia’s deteriorating reputation became a determining factor in the contraction of this industry. Much of this demise can be attributed to a single Colombian garment firm that took a contract (for 50,000 men’s suits) that was beyond their capability. The poor-quality result so tarnished the American importer’s name that other high-quality importers became wary of Colombian-sewn garments. With the payoff to high-quality production reduced, Colombian garment firms then concentrated on low-quality markets, and the newly-found unfavorable reputation was justified.”

omy has a poor reputation for quality in the importing country. In that respect, reputation has self-perpetuating features since future national reputation adjusts to past exports quality. These issues are particularly relevant for developing countries trying to grow into exporting increasingly sophisticated goods. National reputations create history dependence in the range of goods a country can successfully export. A damaged national reputation is a barrier to entry for companies that develop more expensive high-quality products, threatening the success of such a growth strategy. To overcome the adverse aggregate effects of asymmetric information, the optimal policy critically depends on whether the country's initial equilibrium is a high-quality or a low-quality one. In cases with low initial reputation, we find that policies that lower the cost of exporting can lead to a welfare gain by improving the country's long-run average quality and reputation. We also show that policies inducing a positive jump in consumer beliefs can have self-fulfilling effects on the quality of exports if the shock is sufficiently large, but have no long-run effects if the shock is small. Export subsidies are, however, detrimental to both reputation and welfare in countries already exporting high-quality products, as they encourage the entry of "fly-by-night" unreliable firms.

This paper could be enriched in several directions. We have developed a model with reduced-form import demand, abstracting from the determinants of demand for domestic versus foreign goods. We could explore further the conditions under which developing countries end up specializing in low-quality exports by introducing within-sector competition between domestic and foreign firms and non-homothetic preferences for quality. Both country reputations and the sensitivity of host market consumers to quality will be determinants of within-industry specialization across countries. Specifically, as long as the elasticity of demand to perceived quality rises

with income, we expect that asymmetric information concerns will affect exports from developing countries to advanced countries more than to other developing countries. Hence, the relative force of factor-driven comparative advantage and “reputational comparative advantage” will shape export patterns differently both in more versus less differentiated industries and towards high- versus low-income destination markets.

Regarding policy responses, we have focused on country-level economic and trade policies, designed to enhance the position of a country’s exports along the quality ladder. Going further, our analysis provides a framework for a richer understanding of firms’ sourcing decisions through the lens of a strategic use of “made in” rules. Exporters can find it optimal to resort to original equipment manufacturers or depart from the cost-minimizing way of splitting the production process across locations, in order to obtain a favorable country-of-origin denomination. The location of manufacturing and assembly will be decided not only according to cost considerations, but also depending on the regulations surrounding rules of origin, consumer sensitivity to quality, and the degree of asymmetric information in the industry. An extension of our model along these lines would generate testable predictions at the firm level. These topics will be investigated in future research.

2. FINANCIAL CONSTRAINTS AND MULTINATIONAL CAPITAL STRUCTURE

2.1 Introduction

There is huge variation in the extent to which the foreign subsidiaries of multinational firms are financed in the local debt or equity market or through parent financing. In 2008, majority-owned foreign affiliates of nonfinancial US companies raised over 45% of their external funds (excluding retained earnings) in the host country, and only 24% from the parent. As shown in Table 2.1, the host country share was as high as 60% in Japan, and as low as 27% in Israel .

Why do multinational firms choose to finance the capital expenditures of their affiliates in the home or in the host market? The existing literature has emphasized tax regimes, exchange rate variability and creditor rights (e.g. Desai, Foley, and Hines, 2004). Affiliates seem to substitute between local debt and debt from parent companies to arbitrage differences in corporate tax rates and financial conditions. Other papers have focused on the role of subsidiary debt to incentivize local managers (e.g. Antràs, Desai, and Foley, 2009). In this paper, we will argue that local financing is a (possibly costly) diversification strategy when business cycles are not perfectly correlated across markets and the multinational faces a risk of financial distress. The parent can exploit differences in creditor protection across countries, choosing its capital structure to minimize the overall cost of capital as well as the risk of bankruptcy.

Table 2.1: External financing of US majority-owned foreign affiliates (in %). Source: Bureau of Economic Analysis Survey of Direct Investment Abroad, 2008.

	Host country share	Parent share
All countries	45.1	24.2
Japan	60.2	17.4
UK	58.4	22.3
Germany	51.1	19.6
France	48.7	21.9
South Africa	42.7	29.6
China	42.3	34.1
Mexico	37.2	38.6
India	37.2	38.9
Brazil	35.3	30.3
Chile	31.9	43.6
Nigeria	29.0	16.3
Israel	27.5	51.7

Hence, we will abstract from contractual frictions and focus on a case where the only difference between arm's length partners and foreign affiliates is the latter's access to internal capital markets and the ex post reallocation of cash flows across subsidiaries.

Specifically, we restrict our attention to horizontal FDI, and point out two main characteristics of multinational operations. As opposed to domestic conglomerates, multinational enterprises (MNEs) derive revenue and profits from sales in several markets, and are thus affected by demand shocks in several countries as well as by exchange rates. And as opposed to exporting firms, they own assets in several countries through their subsidiaries, and can use them as collateral to borrow on host markets. The former can be a source of either diversification or additional risk, depending on the correlation between foreign and domestic profits. The latter provides the company with the opportunity to make a strategic use of home and host country credit markets, and lower its overall borrowing costs in the presence of financial frictions.

We restrict our attention to debt finance, since the vast majority of subsidiary funding takes place through debt rather than equity or other contractual arrangements.

We explore the determinants of local versus parent borrowing under three main assumptions. First, there is *ex ante* uncertainty about the profitability of each market, leading to a risk of bankruptcy for externally financed firms if demand is low. Second, due to collateral constraints, not all projects with positive expected returns are funded by creditors. Third, countries have different levels of financial development, affecting banks' ability to recover collateral in case of default. We derive the following main effects. A multinational affiliate's borrowing costs on the host market relative to the home market decrease in local financial development, and increase in the informational disadvantage of home banks about foreign assets. Moreover, having operations in several, imperfectly correlated markets stabilizes the cash flow of MNEs, which lowers the likelihood of distress for sufficiently productive firms. However, if affiliates are funded through parent debt raised on the home market, joint balance sheets create a contagion risk for less productive firms: financial distress in an affiliate can force the whole firm into bankruptcy. Borrowing in local markets mitigates this risk by providing firms with the option to select the market in which they default. In countries with low financial development, these firms face a tradeoff between higher interest rates on local debt and a higher risk of liquidation with parent debt. We show that the correlation of business cycles between the home and host markets plays a key role in this tradeoff. Finally, we find that host country debt has an additional benefit in the presence of foreign exchange risk. Local debt, denominated in foreign currency, provides a hedge against fluctuations in profits due to exchange rate movements. Holding constant financial development, debt raised on local markets becomes more attractive when the risk of a currency depreciation rises.

This financing channel has important implications for the relationship between FDI and capital flows. The choice of local or parent debt affects the extent to which FDI does create a capital inflow to host countries, which is key for developing and emerging economies. Countries strive to attract FDI from foreign companies that will provide technology, jobs, and funds. But if these companies finance their subsidiaries' investments locally, they may crowd out credit to local firms. Alternatively, the involvement of multinational affiliates may contribute to developing host financial markets. Although this question is beyond the scope of this paper, we will shed light on the conditions which make either local borrowing or capital inflows more likely. Lastly, their capital structure also affects the degree to which multinational firms' liabilities can act as a channel for the international transmission of demand shocks. Parents with locally financed affiliates are more insulated against foreign recessions than parents raising external finance on their own to fund their subsidiaries. Hence, their financing choices contribute to either amplifying or mitigating the transmission of shocks.

The remainder of the paper is organized as follows. Section 2.2 reviews the literature on internal capital markets and multinational finance. Section 2.3 lays out the building blocks of the model. Section 2.4 derives the optimal debt mix of multinational firms. Section 2.5 introduces exchange rate risk. Finally, Section 2.6 tests some empirical predictions of the model.

2.2 *Literature*

There is a large corporate finance literature about the benefits and costs of internal capital markets in a domestic setting, surveyed by Stein (2003) and Maksimovic and Phillips (2007). On the "bright side", diversification within a firm allows headquarters

to reallocate funds across divisions and engage in winner-picking if they are better informed about the prospects of different divisions than external actors, and it allows for better monitoring than bank lending (Gertner, Scharfstein, and Stein, 1994; Stein, 1997; Hubbard and Palia, 1999). As internal funds are less costly to raise than external funds, reallocating resources across divisions relaxes credit constraints by limiting the need for costly external finance. However, there is also a “dark side” to internal capital markets. The ex post reallocation of cash flows can facilitate overinvestment in divisions with bad prospects; dilute the effort of divisional managers; generate distortionary rent-seeking and lobbying activities over the division of cash flows; lower incentives to repay external debt; and create comovement of returns between unrelated divisions (Scharfstein and Stein, 2000; Rajan, Servaes, and Zingales, 2000; Brusco and Panunzi, 2005; Inderst and Muller, 2003; Ozbas and Scharfstein, 2010; Wulf, 2009). Overall, determinants of whether internal capital markets help or hurt a company’s value in these papers are the variability of investment opportunities and cash-generating activities across divisions within the firm, as well as the degree of credit constraints and the severity of agency problems. This literature has focused on domestic conglomerates, which differ from multinational firms in several respects. First, rather than having activities in several unrelated industries, the primary source of diversification within multinational enterprises is geographical. Second, unlike domestic firms, they are able to obtain external finance on several segmented capital markets since they can put up collateral in foreign countries. These two features will be key to our analysis. Third, the degree of information asymmetry between headquarters and division managers is potentially higher within firms operating in different countries.

A recent theoretical literature has incorporated financial frictions into theories of

international firms. Manova (2011) and Chaney (2005) study how liquidity constraints affect the behavior of exporting firms, but do not consider multinational firms. Noe (1999) looks directly at the choice of parent versus subsidiary debt for a multinational operating in a country with different creditor rights. The main mechanism in his model is the ability to renegotiate ex post, which allows multinationals to exploit conflicts of interest between domestic and local creditors. He predicts that the debt mix will place a larger weight on the more creditor-friendly financial system, and that MNEs with lower distress risk will rely less on local credit markets. One difference between his model and ours is that we rule out renegotiation but focus on bankruptcy risk and inefficient liquidation. Most importantly, Noe's framework, which features a single project in the foreign country, misses a crucial characteristic of multinational firms: not only can they borrow in several credit markets, but they also receive cash flows from several product markets. Instead of looking at one project in isolation, a key parameter of our model will be the correlation of cash flows across markets and its effect on the company's default risk. Ramondo and Rappoport (2008) consider explicitly how the correlation of shocks between home and host markets affects the decision to serve a foreign market through exports or affiliate sales: country pairs with less correlated business cycles should have larger bilateral trade relative to affiliate sales. Contrary to us, they assume perfect financial markets and thus disregard the role of international diversification in overcoming financial frictions. Moreover, they are silent about the mix of internal and external debt in subsidiaries.

Two papers study the choice of local versus parent finance in a setting in which local managers need to be incentivized. Marin and Schnitzer (2011) look at the role of local financing in alleviating concerns that the manager may fail to expend effort or may hide returns from the parent. Their model predicts that even if internal financing

is available and less costly, local external finance is chosen when the agency problems are severe. Antràs, Desai, and Foley (2009) also focus on the impact of managerial misbehavior on multinational activity and subsidiary financing. In their model, parent funding arises in the optimal contract between the entrepreneur, external funders and affiliates in countries with weak investor protection. As parents are better able to monitor managers, banks require their participation to overcome the paucity of creditor rights. They predict that both the share of arm's length technology transfers and the share of external financing rise with the strength of creditor protection. However, both of these papers consider one project only, shutting off the effect of the affiliate's returns on the overall financial health of the firm. Indeed, they assume that the parent firm faces no financial constraints in its home country. Instead, we abstract from incentive concerns, assuming that the probability of high returns is independent of managerial effort, but focus on the effect of the comovement of returns as well as host country financial development on the firm's financing choices.

A last strand of literature related to this paper consists of empirical studies of the financing choices of multinational companies. Feinberg and Phillips (2002) find evidence that in countries with less developed financial markets, affiliates compete for resources with their US parents, leading to financing tradeoffs within affiliate networks. Then, a series of empirical papers used detailed data on the affiliates of US multinational companies to study their reliance on internal capital markets. Desai, Foley, and Hines (2004) show that the capital structure of subsidiaries responds opportunistically to financial frictions. Affiliates in countries with higher corporate tax rates borrow more externally, and less from parent companies. They also raise less external debt in countries where financial markets are less developed, and three quarters of this difference is substituted for by borrowing from parent companies.

In related papers, Desai, Foley, and Hines (2006) find that MNEs take advantage of internal capital markets to circumvent capital controls, by adjusting reported profitability and dividend repatriations; and Desai, Foley, and Hines (2007) identify domestic financing needs as one of the determinants of the dividend repatriation policy of financially constrained multinationals. Finally, Desai, Foley, and Forbes (2008) find that US affiliates expand sales and investment more than local firms following sharp currency depreciations; the difference is not driven by different investment opportunities but different abilities to deal with financial constraints, as MNE affiliates are able to obtain more financing from parents in large depreciation episodes.

2.3 *Model setup*

This section presents the building blocks of the model. To keep matters simple, we build a two-country framework in which firms serve both markets and must decide on their organizational form and debt structure. In order to highlight the financing channel, we abstract from managerial incentive concerns.

2.3.1 *Production and demand*

Suppose the home country and the foreign country are symmetric in terms of size and labor costs but differ in financial development. We study the horizontal FDI decision from the perspective of a home firm. There are three periods in this economy (times 0, 1 and 2), and a continuum of entrepreneurs. Each of them owns the technology to produce and sell a good with productivity θ , distributed on $[\underline{\theta}, \bar{\theta}]$. The productivity level is exogenous, drawn from a distribution $G(\theta)$, and observable.

At the time investment and financing decisions are made, there is uncertainty about the future demand level in each market. More precisely, in order to sell in a

given market, a capital outlay of I must be sunk in period 0. Once this expense is incurred to set up a plant, production can take place in this country for the next two periods. The demand level is stochastic and revealed after investment is realized but before production takes place. With probability p_H , demand is high (state H) and revenue is θR_H in each period if the firm still exists then¹. With probability $p_L \equiv 1 - p_H$, demand is low and revenue is θR_L , where $R_L < R_H$ ². These unconditional probabilities and revenues are identical in the two countries. We also define p_{HH} , p_{LL} and p_{HL} as the probabilities of, respectively, observing states (H, H^*) , (L, L^*) and either (L, H^*) or (H, L^*) .

Finally, capital is illiquid and depreciates over time. The value of installed capital to the firm is I in period 0, L in period 1 and 0 in period 2, where $L < I$. This value L corresponds to the resale value of fixed capital on the local market. We assume that $2\theta R_H > I > 2\bar{\theta} R_L$ and $\theta R_L > L$ ³. There is no discounting.

2.3.2 Debt contracts

Financial environment

The entrepreneur has no own wealth and must finance capital outlays through external borrowing. We assume he cannot raise additional equity. The firm enters into a standard debt contract with a bank. The banking sector is competitive, so that

¹ It is straightforward to generalize to a case where demand follows a Markov process and the conditional probability of staying in the same state is higher than the probability of switching.

² This reduced-form revenue can be derived, for instance, from a constant elasticity of substitution utility function with monopolistic competition and stochastic aggregate demand.

³ These assumptions are meant to focus our attention on the implications of inefficient liquidation rather than on voluntary exit decisions. We take the range $[\underline{\theta}, \bar{\theta}]$ to identify firms for which serving the foreign market is potentially profitable, thus excluding the least productive ones as in Melitz (2003). Intuitively, we are assuming that there is “not too much” variance in productivity among entrepreneurs and high uncertainty about demand conditions.

banks make zero expected profits on every loan.

Suppose for now that the firm only operates in its home country. In order to fund the firm's activity on its domestic market, the bank lends the initial investment I to the entrepreneur, against promised repayments of $\frac{D_A}{2}$ in each of periods 1 and 2, where $D_A \geq I$. Thus, $\frac{D_A - I}{I}$ is the interest rate or borrowing cost, which we will derive below. It will be determined by both country-level financial imperfections and firm-specific default risk.

The financial friction comes from the fact that only physical is pledgeable, while future revenue is not. If the firm fails to make the promised payment in period 1, the bank can seize its physical assets and sell them on the secondary market. If it does so, it obtains a liquidation value γL . It cannot seize the firm's revenue itself. The parameter $\gamma < 1$ captures the bank's ability to recover collateral and is our measure of financial development. Banks cannot realize the full resale value of installed capital for several reasons: the manager may be able to hide some of the collateral; the bank will incur legal fees; it does not know the market and potential buyers as well as the firm itself, etc.

Arm's length production contracts

Serving the foreign market involves two related decisions. First, the firm must decide whether to contract with an independent foreign firm which will serve the foreign market, or open an affiliate abroad. Second, if it undertakes FDI, it can choose where to borrow. We start by characterizing the contracts under arm's length production, whereby the entrepreneur licenses the firm's technology to a foreign producer.

In this case, the entrepreneur makes a take-it-or-leave-it offer to a local foreign firm to license the technology. In exchange of the right to sell the product, he receives an

upfront transfer equal to expected foreign profits. The foreign supplier then borrows on her own from a local foreign bank, produces and sells.

The debt contract is similar to that of the home country, except that the level of financial development γ^* may differ. Thus, the foreign firm borrows I , collateralized by its fixed capital, against promised repayments of $\frac{D_A^*}{2}$ in periods 1 and 2, where $D_A^* \geq I$. If it fails to repay, the foreign bank seizes its assets in period 1 and receives the liquidation value γ^*L . The balance sheets of both firms are entirely independent.

Without loss of generality, we assume that the foreign country is less financially developed than the home country: $\gamma > \gamma^*$.

Foreign direct investment contracts

If the firm sets up a wholly-owned affiliate abroad, it pools the parent and subsidiary's liabilities and borrows a total of $2I$. We rule out capital controls, so that profits can be freely transferred across borders. There are two financing options. First, the multinational can replicate the debt of two independent firms. In this case, it borrows from both a home bank and a foreign bank, where each loan is collateralized by local assets. The total face value of the debt is noted $D_F + D_F^*$, to be repaid in half every period.

Second, it can borrow the full amount of both investments from the home bank only. We note the corresponding face value of the debt $2D_I$, and the debt contract requires a payment of D_I per period. Foreign assets can be used as collateral; however, in the event of liquidation, the home bank has an informational disadvantage in selling foreign assets. Hence, it can only recover a value $\gamma \underline{L}$ from the firm's foreign capital, as opposed to γL from domestic capital, where $\underline{L} < L$.

While γ indexes the country's financial development through the degree of en-

forcement of debt contracts, the gap between \underline{L} and L is meant to reflect technical and informational issues. In particular, it may reflect the geographical specificity of the fixed assets being liquidated, or high transport costs for physical capital. Alternatively, the less the bank has information about or partners in the foreign country, the larger the discount it will have to incur in order to sell the assets locally.

2.3.3 *Timing*

The timing of events proceeds as follows:

- At time 0, the entrepreneur decides whether to license the technology to a foreign firm or undertake FDI. If he sets up an affiliate, he decides where to borrow. The initial capital investment I is made in each country.
- At time 1, the state of nature H or L is revealed in each country. Firms produce, sell, and make the first debt payment if they are able to. If not, every bank that has not been repaid seizes and liquidates the collateral.
- At time 2, production and sales take place again in every plant that has not been liquidated. The second debt payment is made. The firm has no more activity.

2.4 *Choice of capital structure*

2.4.1 *First best*

Suppose there are no financial market imperfections. Since external finance is the only source of frictions in the model, the organizational form and capital structure are then irrelevant. According to the first best allocation of funds, an investment is

undertaken if and only if it has a positive net present value, that is if:

$$2\theta\bar{R} \geq I$$

where we define

$$\bar{R} \equiv p_H R_H + p_L R_L$$

such that the expected revenue per period is $\theta\bar{R}$ for a firm of productivity θ . Hence, all firms with

$$\theta \geq \theta_{FB} \equiv \frac{I}{2\bar{R}} \quad (2.1)$$

sell in the home and foreign markets in both periods. At $t = 1$, liquidation is inefficient, so plants are never shut down.

2.4.2 *Borrowing costs and default risk*

Licensing

Now let us examine the debt contracts with financial imperfections. Under arm's length technology transfer, the two firms function as separate legal entities with independent balance sheets. Since $I > 2\bar{\theta}R_L$, whenever the low state occurs in a country, the corresponding firm fails to meet its debt payments and is liquidated in period 1. The home bank (respectively, foreign bank) receives D_A (respectively, D_A^*) in the high state, and γL (respectively, $\gamma^* L$) in the low state. Using the bank's expected zero profit condition, we derive the face value of the debt of the home firm and the foreign firm:

$$D_A = I + \frac{p_L}{p_H} (I - \gamma L) \quad (2.2)$$

$$D_A^* = I + \frac{p_L}{p_H} (I - \gamma^* L) \quad (2.3)$$

The expected profits of each firm, respectively π_A and π_A^* , are its expected sales revenue net of principal and interest payments. If R_H occurs, it sells in both periods and fully repays its debt. If R_L occurs, it sells in the first period only and defaults on the debt. Hence,

$$\begin{aligned} \pi_A &= p_H [2\theta R_H - D_A] + p_L \theta R_L \\ &= 2\theta \bar{R} - I - p_L [\theta R_L - \gamma L] \end{aligned} \quad (2.4)$$

and

$$\begin{aligned} \pi_A^* &= p_H [2\theta R_H - D_A^*] + p_L \theta R_L \\ &= 2\theta \bar{R} - I - p_L [\theta R_L - \gamma^* L] \end{aligned} \quad (2.5)$$

The first term in the expected profit is the net present value of the investment $2\theta \bar{R} - I$, which also corresponds to expected profits under perfect capital markets. The second term is the cost of liquidation. Here, the only ex ante difference between the two firms is that lower financial development in the foreign country results in higher borrowing costs and lower expected profits. Since the foreign bank can recover a lower fraction of physical assets in the event of default, it compensates for the more acute default risk by charging a higher interest rate.

It immediately follows that firms produce at home if and only if $\theta \geq \theta_A$ and abroad if and only if $\theta \geq \theta_A^* > \theta_A$, where:

$$\theta_A = \frac{I - p_L \gamma L}{2\bar{R} - p_L R_L} \quad (2.6)$$

and

$$\theta_A^* = \frac{I - p_L \gamma^* L}{2\bar{R} - p_L R_L} \quad (2.7)$$

The latter is decreasing in γ^* , so that we expect more activity in more financially developed countries.

FDI with home country debt

Under FDI with domestic debt, the parent firm decides to set up a foreign affiliate through FDI and borrows $2I$ from the home bank only, against future payments of D_I per period. In each of periods 1 and 2, it receives cash flow from sales in both countries. The whole firm, i.e. both plants, is liquidated if it is unable to meet its payment in period 1. Hence if both countries have low revenue, the firm is liquidated in period 1. If only one has low revenue, two cases may arise.

On the one hand, if the firm is able to repay its debt when only one country yields high revenue (“diversification case”), then the bank’s zero profit condition yields the following expected debt payment $D_{I,D}$:

$$D_{I,D} = I + \frac{p_{LL}}{1 - p_{LL}} \left[I - \frac{\gamma}{2} (L + \underline{L}) \right] \quad (2.8)$$

and expected worldwide profits are:

$$\pi_{I,D} + \pi_{I,D}^* = 2 [2\theta\bar{R} - I] - p_{LL} [2\theta R_L - \gamma (L + \underline{L})] \quad (2.9)$$

The condition for the firm to be in the diversification region is

$$\theta (R_H + R_L) \geq I + \frac{p_{LL}}{1 - p_{LL}} \left[I - \frac{\gamma}{2} (L + \underline{L}) \right] \quad (2.10)$$

which is more likely to hold for high productivity firms. In this setting, multinational activity – as opposed to contracting with a separate entity – provides diversification benefits. It enables the firm to use cross-subsidization between its plants in order to avoid an inefficient liquidation in states of the world in which, for instance, one country experiences a recession but the other one does not. Importantly, the more comovement of revenue there is between the firm’s home and foreign markets, the higher the ratios $\frac{p_{LL}}{p_L}$ and $\frac{p_{HH}}{p_H}$, and the less likely it is that the firm will need to transfer cash flows between its divisions. Thus the scope for diversification, and the associated interest rate discount compared to independent firms, falls with the correlation of business cycles between countries.

On the other hand, if the firm does not have enough revenue to cover its debt payments when one country only is in the high state (“contagion case”), then it is liquidated in every state except (H, H^*) . The corresponding debt payments and profits are:

$$D_{I,C} = I + \frac{1 - p_{HH}}{p_{HH}} \left[I - \frac{\gamma}{2} (L + \underline{L}) \right] \quad (2.11)$$

$$\pi_{I,C} + \pi_{I,C}^* = 2 [2\theta\bar{R} - I] - 2\theta [p_{HL}R_H + p_L R_L] + (1 - p_{HH}) \gamma (L + \underline{L}) \quad (2.12)$$

The contagion case occurs if condition (2.10) does not hold. Then, instead of providing opportunities for diversification, a multinational firm which is financially responsible for its affiliates is vulnerable to the risk that bad shocks will have a ripple effect across its divisions. When one country is in the high state and the other one in the low state, the whole firm’s assets are still seized by the bank, including the plant that yields high revenue. This leads to more frequent liquidations than when the home and foreign producer are independent firms.

FDI with domestic and foreign debt

Under FDI with borrowing on both markets, the firm borrows I from a domestic bank and I from a foreign bank, each loan being collateralized with local assets. It has to repay $\frac{D_F}{2}$ to the home bank and $\frac{D_F^*}{2}$ to the foreign bank in each of periods 1 and 2. We distinguish again between two cases depending on whether pooling resources lowers or increases default risk.

Following the same logic as in the previous case, if sales revenues $\theta(R_H + R_L)$ suffice to cover the per-period debt payment, the firm only defaults when both countries are in the low state. In state (L, L^*) , it defaults on both loans. Therefore, we have:

$$D_{F,D} = I + \frac{p_{LL}}{1 - p_{LL}} [I - \gamma L] \quad (2.13)$$

$$D_{F,D}^* = I + \frac{p_{LL}}{1 - p_{LL}} [I - \gamma^* L] \quad (2.14)$$

$$\pi_{F,D} + \pi_{F,D}^* = 2 [2\theta\bar{R} - I] - p_{LL} [2\theta R_L - (\gamma + \gamma^*) L] \quad (2.15)$$

The condition for this diversification case to exist is that $\theta(R_H + R_L) \geq \frac{1}{2}(D_{F,D} + D_{F,D}^*)$ or equivalently

$$\theta(R_H + R_L) \geq I + \frac{p_{LL}}{1 - p_{LL}} \left[I - \frac{\gamma + \gamma^*}{2} L \right] \quad (2.16)$$

If condition (2.16) does not hold, then the firm does not benefit from pooling risks. If only one country is in a recession, the entrepreneur can choose where to default and will thus declare bankruptcy in a given country whenever it is in the low state. Hence, the terms of the debt contracts and expected profits are equivalent to the licensing case.

$$D_{F,C} = I + \frac{p_L}{p_H} (I - \gamma L) \quad (2.17)$$

$$D_{F,C}^* = I + \frac{p_L}{p_H} (I - \gamma^* L) \quad (2.18)$$

$$\pi_{F,C} + \pi_{F,C}^* = 2 [2\theta\bar{R} - I] - p_L [2\theta R_L - (\gamma + \gamma^*) L] \quad (2.19)$$

Finally, we assume that when the entrepreneur is indifferent between integration and licensing, he chooses to license the technology.

2.4.3 Optimal capital structure

High financial development

Suppose the foreign country has high financial development, which we define as:

$$\gamma^* L \geq \gamma \underline{L}$$

Then we can prove that it is never worth borrowing funds for the foreign investment from the home bank. Intuitively, the comparative disadvantage of the home bank in selling geographically distant assets outweighs its better ability to recover collateral. The interest rate charged by the home bank on a loan for the whole firm therefore exceeds the average interest on two local loans.

Lemma 2.1 *If $\gamma^* L > \gamma \underline{L}$, FDI with both domestic and foreign debt strictly dominates FDI with domestic debt only.*

Proof: see Appendix B.

Also, irrespective of financial development, the choice between FDI with local debt and licensing only depends on whether the firm is in the diversification or in the contagion region. If a common balance sheet enables the firm to reduce its probability of bankruptcy, FDI is better than selling through a separate firm. If it raises

the probability of bankruptcy, the firm is better off contracting the technology to an independent producer. This result is formalized in Lemma 2.2.

Lemma 2.2 *If condition (2.16) holds, FDI with both domestic and foreign debt strictly dominates licensing. If condition (2.16) does not hold, FDI with both domestic and foreign debt is equivalent to licensing.*

Proof: see Appendix B.

Having established these two results, we proceed to characterize the optimal structure of a firm operating in its domestic market and in a highly financially developed foreign market. Since the costs associated with financial frictions are higher in the foreign market, there is a range of firms – the least productive among domestically active firms – for which serving the foreign market is not profitable. Among those that do sell abroad, the most productive ones are in the diversification region, set up an affiliate and borrow in both markets. Intermediate productivity firms prefer to isolate their balance sheets from the risk of contagion and operate through two separate entities, as long as doing so yields positive expected profits. This sorting is formally described in Proposition 2.1.

Proposition 2.1 *Optimal financial structure with high financial development:*

*If $\gamma^*L > \gamma\bar{L}$,*

(i) Firms with $\theta < \theta^$ do not produce for the foreign market, where*

$$\theta^* = \begin{cases} \theta_A^* & \text{if } \theta_A^* \leq \theta_F \\ \max\{\theta_F^*, \theta_F\} & \text{if } \theta_A^* > \theta_F \end{cases}$$

$$\theta_A^* = \frac{I - p_L \gamma^* L}{2R - p_L R_L};$$

$$\begin{aligned}\theta_F^* &= \frac{I - \frac{1}{2}p_{LL}(\gamma + \gamma^*)L}{2\bar{R} - p_{LL}R_L}; \\ \theta_F &= \frac{I - \frac{1}{2}p_{LL}(\gamma + \gamma^*)L}{(1 - p_{LL})(R_H + R_L)}.\end{aligned}$$

(ii) Firms with $\theta_A^* \leq \theta \leq \theta_F$ produce for their home market and license their technology to an independent foreign firm.

(iii) Firms with $\theta > \max\{\theta_F^*, \theta_F\}$ produce for their domestic market, open a subsidiary and borrow in both markets.

Proof: see Appendix B.

Low financial development

Suppose the foreign country has low financial development, i.e.

$$\gamma^*L \leq \gamma\underline{L}$$

Contrary to the high financial development case, FDI with home borrowing only now strictly dominates FDI with local borrowing when the firm is able to diversify. The intuition mirrors the reasoning of the previous section: even though the home bank obtains a lower value for the foreign assets it liquidates than a local bank, its better ability to recover them more than makes up for this disadvantage. It is therefore able to charge a lower interest rate on a loan covering the firm's worldwide investments.

Lemma 2.3 *If $\gamma^*L < \gamma\underline{L}$ and condition (2.10) holds, FDI with domestic debt only strictly dominates FDI with both domestic and foreign debt.*

Proof: see Appendix B.

Therefore, FDI with local borrowing will not be used in the diversification region in countries with low financial development. Similarly to Lemma 2.2, we can also prove that if θ is high enough for diversification, the firm prefers FDI with home borrowing to an independent affiliate.

Lemma 2.4 *If $\gamma^*L > \gamma\underline{L}$ and condition (2.10) holds, FDI with home borrowing only strictly dominates licensing.*

Proof: see Appendix B.

Condition (2.10) defines a threshold θ_I above which joint balance sheets provide diversification opportunities:

$$\theta_I \equiv \frac{I - \frac{1}{2}p_{LL}\gamma(L + \underline{L})}{(1 - p_{LL})(R_H + R_L)} \quad (2.20)$$

If $\theta < \theta_I$, the firm's decision needs to balance a capital cost effect and an excess liquidation effect. Borrowing the full amount of worldwide investments from the home bank leads to a higher probability of bankruptcy. However, it also implies a higher liquidation value in the event of default, which lowers borrowing costs. In the contagion region, the difference between profits with FDI and home borrowing and profits with licensing is given by:

$$\underbrace{p_L(\gamma\underline{L} - \gamma^*L)}_{\text{Cost of capital}} - \underbrace{p_{HL}[2\theta R_H - \gamma(L + \underline{L})]}_{\text{Excess liquidation}}$$

so that FDI is preferred to licensing whenever either $\theta > \theta_I$ or

$$\theta < \theta'_I \equiv \frac{p_L(\gamma\underline{L} - \gamma^*L) + p_{HL}\gamma(L + \underline{L})}{2p_{HL}R_H} \quad (2.21)$$

Taking into account the profitability of entry under each organizational form, we can now derive the choice of capital structure by productivity levels.

Proposition 2.2 *Optimal capital structure with low financial development:*

If $\gamma^*L < \gamma\underline{L}$,

(i) *Firms with $\theta < \theta^*$ do not produce for the foreign market, where*

$$\theta^* = \begin{cases} \theta_A^* & \text{if } \theta_A^* \leq \min\{\theta_I, \theta_I'^*\} \\ \theta_I^* & \text{if } \theta_I \leq \min\{\theta_A^*, \theta_I'^*\} \\ \theta_I'^* & \text{if } \theta_I'^* \leq \min\{\theta_A^*, \theta_I\} \end{cases}$$

$$\theta_A^* = \frac{I - p_L \gamma^* L}{2\bar{R} - p_L R_L};$$

$$\theta_I^* = \frac{I - \frac{1}{2} p_{LL} \gamma (L + \underline{L})}{2\bar{R} - p_{LL} R_L};$$

$$\theta_I'^* = \frac{I - \frac{1}{2} (1 - p_{HH}) \gamma (L + \underline{L})}{2\bar{R} - p_L R_L - p_{HL} R_H};$$

$$\theta_I = \frac{I - \frac{1}{2} p_{LL} \gamma (L + \underline{L})}{(1 - p_{LL}) (R_H + R_L)}.$$

(ii) *Firms with $\theta_A^* \leq \theta$ and $\theta_I' \leq \theta \leq \theta_I$ produce for their home market and license their technology to an independent foreign firm, where*

$$\theta_I' = \frac{p_L (\gamma \underline{L} - \gamma^* L) + p_{HL} \gamma (L + \underline{L})}{2p_{HL} R_H}$$

(iii) *Firms with $\theta > \max\{\theta_I^*, \theta_I\}$ or $\theta_I'^* < \theta < \theta_I'$ produce for their domestic market, open a subsidiary and borrow from a home bank only.*

Proof: see Appendix B.

Summing up

Let us sum up the firm's choices according to θ and γ^* . Figure 2.1 presents a case with a low correlation of business cycles between the home and host country, i.e. a high contagion risk (p_{HL} high). In this case, $\theta'_I < \theta'^*_I$ for all values of γ^* , implying that FDI with parent debt never both yields positive expected profits and is preferred to licensing in the contagion region. Hence, in countries with low financial development, we observe no foreign activity when $\theta < \theta^*_A$ (the red line representing θ^*_A), arm's length technology transfer when $\theta^*_A \leq \theta \leq \theta_I$ (the blue line representing θ_I), and FDI with debt raised on the home market above θ_I . In countries with high financial development, there are no foreign sales below θ^*_A , licensing when $\theta^*_A \leq \theta \leq \theta_F$ (the blue line representing θ_F), and FDI with locally raised financing above θ_F . In both cases, the only firms that engage in FDI are those in the diversification region.

Figure 2.2 shows a case with a high correlation of sales between the home and host markets, so that contagion is unlikely. In high financial development countries, everything is identical to the previous figure. However, in less financially developed countries, some firms in the contagion region still engage in FDI in order to take advantage of better creditor rights in the home country. The threshold θ'_I (represented by the dark green line) below which arm's length contracting is less profitable than parent-financed FDI is higher than θ'^*_I (represented by the light green line). Therefore, the prevalence of FDI and home finance is larger, as well as the total volume of foreign activity.

Testable predictions

The simple model we have analyzed yields several testable predictions about multinational activity and the financing of multinational affiliates.

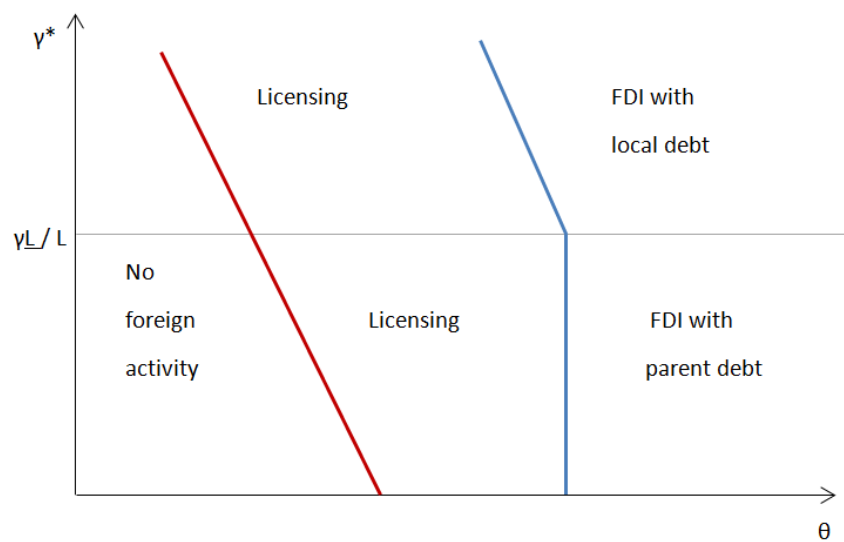


Figure 2.1: Choices of firms with low revenue correlation

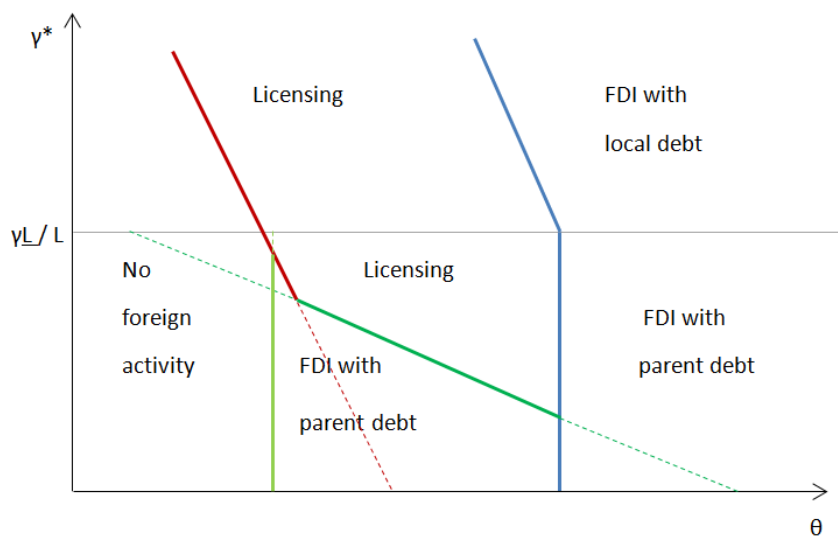


Figure 2.2: Choices of firms with high revenue correlation

Result 2.1 *For given host country creditor rights, a foreign investment is more likely to be conducted in-house if θ is high, and more likely to be contracted out to an outside producer if θ is low.*

This result stems from the fact that holding γ^* constant, highly productive firms are led to engage in MNE activity, rather than licensing, by a diversification motive (reducing overall default risk and borrowing costs). The same mechanism works against multinationals with lower θ , which are subject to a risk of contagion and avoid it by serving the foreign market through an independent firm.

Result 2.2 *Multinational activity in countries with low financial development is more prevalent, relative to arm's length production, the higher the correlation of profits across countries. Multinational activity in countries with high financial development may be less prevalent, relative to arm's length production, the higher the correlation of profits across countries.*

The first part of this result comes from the role of contagion risk. In countries with low financial development, more correlated sales across markets lower the probability of contagion, which arises when profits are high in one country and low in the other. Hence, a high correlation tilts the tradeoff between lower borrowing costs and a lower risk of liquidation towards borrowing in the home country to serve both markets through affiliate sales.

The second part of this result deals with the diversification benefits of multinational activity. A higher correlation of sales across markets makes these diversification opportunities less relevant, leading firms to favor licensing technology to local producers. However, we have seen that when the default risk is not reduced by producing in-house, licensing and setting up an affiliate are still equivalent in terms of expected profits, so that the prediction is not a strong one.

Result 2.3 *The propensity of multinationals to borrow in host markets increases in local financial development γ^* and decreases in the distance to the home country and geographic specificity of physical assets ($L - \underline{L}$).*

These predictions are fairly intuitive: a high γ^* and a high \underline{L} both lower the cost of borrowing from local banks relative to home banks, making local borrowing more attractive. Hence, among all US multinationals having affiliates in foreign countries, we expect the share of local debt in affiliates' external financing, relative to parent financing, to increase with the development of local credit markets and decrease with distance to the United States.

Finally, although we provide no formal welfare analysis in this paper, let us make a few comments about the efficiency costs and benefits of multinational activity in this setting. On the one hand, the ability to pool risks and borrow on home terms may increase total investment in countries with low financial development. This is the case when financial frictions are high enough to deter investment by some local firms, but multinational affiliates of similar productivity are profitable because of the parent firm's ability to borrow on its domestic market at lower rates. Moreover, in financially developed countries, multinational affiliates experience financial distress less often than both comparable local firms and comparable home firms that do not sell abroad, since they are able to pool cash flows and thus lower their default probability.

On the other hand, in less financially developed countries, there is a range of productivity levels for which multinationals experience financial distress more often than local and home firms of similar productivity, as they take on a higher bankruptcy risk in order not to incur the foreign country's high borrowing costs. Hence, when financial frictions are large in the host country, FDI can mitigate one source of inefficiency (the fact that some investments with positive expected returns are not funded) but

may worsen another one (inefficient liquidations).

2.5 *Exchange rate risk*

In the previous section, we ignored exchange rate concerns in the firm's choice of where to borrow the funds for its foreign investment. In practice, exchange rate fluctuations change the home currency value of repatriated profits. Through this channel, they can affect the tradeoff between home country and host country debt, as local debt provides a hedge against exchange rate variations. We assume that host country debt is denominated in the foreign currency. We model currency risk in a very simple way as the probability of a severe exchange rate crisis⁴. Naturally, introducing exchange rate risk does not affect the default probabilities and borrowing conditions of independent home and foreign firms, so we will focus on the cases with foreign subsidiaries.

2.5.1 *FDI with host country debt*

Suppose a currency crisis occurs with a small probability λ in the foreign country at time 1, making foreign currency worthless in the home country. Both foreign revenue and host country debt see their value plummet in crisis episodes. The firm will default on its payments to the home bank if the state is (L, L^*) , or if it is (L, H^*) and a currency crisis occurs. In the latter case, the exchange rate shock prevents subsidization from the foreign plant to the home plant. It will also default on its payments to the foreign bank in state (L, L^*) .

Hence in the diversification region, the face value of the firm's debts now takes

⁴ The model could easily be extended to account for smaller exchange rate fluctuations. It would deliver the same qualitative results.

into account the increased default risk:

$$\begin{aligned} D_{F,D} &= I + \frac{p_{LL} + \lambda p_{HL}}{1 - p_{LL} - \lambda p_{HL}} [I - \gamma L] \\ D_{F,D}^* &= I + \frac{p_{LL}}{1 - p_{LL}} [I - \gamma^* L] \end{aligned} \quad (2.22)$$

and the condition for the firm to be in the diversification zone is:

$$\theta \geq \theta_F \equiv \frac{1}{2(R_H + R_L)} \left(\frac{I - (p_{LL} + \lambda p_{HL}) \gamma L}{1 - p_{LL} - \lambda p_{HL}} + \frac{I - p_{LL} \gamma^* L}{1 - p_{LL}} \right) \quad (2.23)$$

which is more stringent than condition (2.16). In this diversification region, expected profits from home and foreign activities are given by:

$$\begin{aligned} \pi_{F,D} &= 2\theta \bar{R} - I - p_{LL} (\theta R_L - \gamma L) - \lambda \theta p_{HL} R_L \\ \pi_{F,D}^* &= 2\theta \bar{R} - I - p_{LL} (\theta R_L - \gamma^* L) - 2\lambda \theta (p_H R_H + p_{HL} R_L) \end{aligned} \quad (2.24)$$

On the other hand, if (2.23) does not hold, then default probabilities and debt conditions are not changed from equations (2.17) and (2.18) since cross-subsidization was not an option. The exchange rate risk only lowers expected profits, so that in this case:

$$\begin{aligned} \pi_{F,C} &= 2\theta \bar{R} - I - p_L (\theta R_L - \gamma L) \\ \pi_{F,C}^* &= 2\theta \bar{R} - I - p_L (\theta R_L - \gamma^* L) - 2\lambda \theta p_H R_H \end{aligned} \quad (2.25)$$

2.5.2 FDI with home country debt only

If there is only home country debt, a currency crisis in the foreign country may prompt the firm to default on all its obligations. The default risk depends on the

extent of cross-subsidization when one country is in the low state and the other one in the high state. We can distinguish between three cases. In the first case, the revenue from one country in state H suffices to cover the whole debt payment. Then the firm defaults if (L, L^*) occurs, or if (L, H^*) occurs and a currency crisis strikes. Precisely, if $\theta R_H \geq D_{I,D}$ as defined below, then $D_{I,D}$ is the face value of debt:

$$D_{I,D} = \frac{I - \frac{1}{2}\gamma [(p_{LL} + \lambda p_{HL}) L + (1 - \lambda) p_{LL} \underline{L}]}{1 - p_{LL} - \lambda p_{HL}} \quad (2.26)$$

The corresponding expected profits from the home plant and the foreign plant are:

$$\begin{aligned} \pi_{I,D} &= 2\theta\bar{R} - I - p_{LL}(\theta R_L - \gamma L) - \lambda p_{HL}(\theta R_L - \gamma L) \\ \pi_{I,D}^* &= 2\theta\bar{R} - I - p_{LL}(\theta R_L - \gamma \underline{L}) - 2\lambda\theta(p_H R_H + p_{HL} R_L) \end{aligned} \quad (2.27)$$

In the second case, revenue from one country only is never enough to meet the full debt payment, but combined sales from a high revenue country and a low revenue country are. Then, the firm defaults if state (L, L^*) is realized or if there is a currency crisis. Hence, if $\theta R_H < D_{I,D}$ but $\theta(R_H + R_L) \geq D_{I,D'}$ then the expected debt payment is:

$$D_{I,D'} = \frac{I - \frac{1}{2}\gamma [(1 - \lambda) p_{LL} (L + \underline{L}) + \lambda L]}{(1 - \lambda) (1 - p_{LL})} \quad (2.28)$$

and expected profits are:

$$\begin{aligned} \pi_{I,D'} &= 2\theta\bar{R} - I - p_{LL}(\theta R_L - \gamma L) - \lambda(\theta(p_H R_H + p_{HL} R_L) - \gamma L) \\ \pi_{I,D'}^* &= 2\theta\bar{R} - I - p_{LL}(\theta R_L - \gamma \underline{L}) - 2\lambda\theta(p_H R_H + p_{HL} R_L) \end{aligned} \quad (2.29)$$

Otherwise, the only case in which the firm repays its debt is when (H, H^*) is realized and there is no currency crisis. Then, the interest rate is highest and given

by:

$$D_{I,C} = \frac{I - \frac{1}{2}\gamma [(1 - \lambda) (1 - p_{HH}) (L + \underline{L}) + \lambda L]}{(1 - \lambda) p_{HH}} \quad (2.30)$$

while expected profits are lowest and given by:

$$\begin{aligned} \pi_{I,C} &= 2\theta\bar{R} - I - \theta (p_{HL}R_H + p_LR_L) + (1 - \lambda) (1 - p_{HH}) \gamma L - \lambda (\theta p_{HH}R_H - \gamma \underline{L}) \\ \pi_{I,C}^* &= 2\theta\bar{R} - I - \theta (p_{HL}R_H + p_LR_L) + (1 - \lambda) (1 - p_{HH}) \gamma \underline{L} - \lambda \theta p_{HH}R_H \end{aligned}$$

2.5.3 Choice of capital structure

The choice of capital structure follows the same determinants as in section 2.4, and an additional hedging concern. The possibility of a currency crisis, albeit small, disadvantages home debt compared to local debt denominated in foreign currency. In the event of a sharp depreciation, the home currency value of domestic debt remains unchanged in the face of falling revenues from foreign sales, while the value of foreign-denominated debt falls accordingly.

In highly financially developed countries ($\gamma^*L > \gamma\underline{L}$), we found that borrowing from the home bank only was never an optimal choice. Introducing exchange rate variation, which reduces the relative attractiveness of parent finance, does not affect this result. The main effect is to raise the productivity threshold above which MNE activity is preferred to licensing. As the diversification condition (2.23) is stricter than (2.16), the relative prevalence of affiliates falls with the probability of currency crisis.

In less financially developed countries ($\gamma^*L < \gamma\underline{L}$), the hedging benefits of foreign debt make licensing and local borrowing more attractive for intermediate θ , even though interest rates are higher on foreign capital markets. Contrary to the previous case where $\lambda = 0$, FDI with local debt is not always strictly dominated by FDI with home debt only, so that for some values of γ^* all organizational forms may arise. The

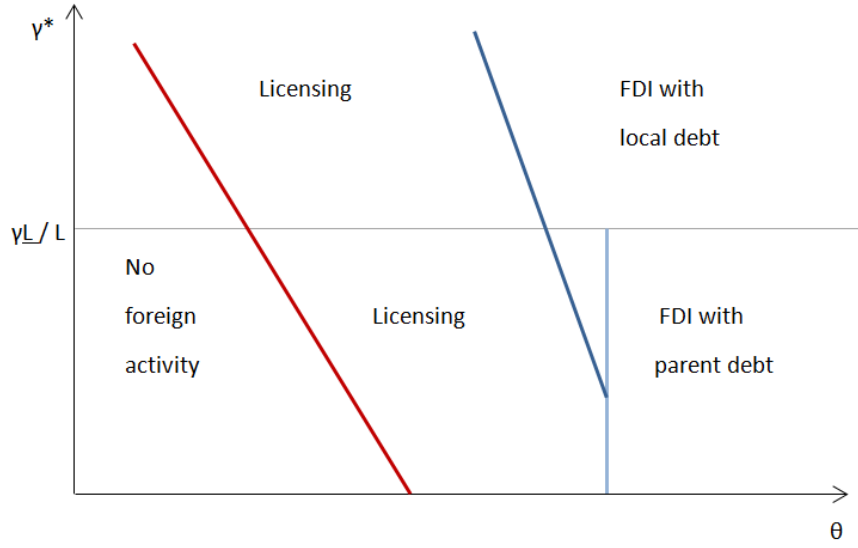


Figure 2.3: Choices of firms with exchange rate risk and low revenue correlation

highest productivity firms, for which $\theta R_H \geq D_{I,D}$, still choose to borrow the totality of their funds from their home market. But if γ^* is not too small, there is a range of intermediate productivity firms – among those that satisfy $D_{I,D} > \theta R_H \geq D_{I,D'}$ – for which the benefits of a lower exchange rate risk outweigh the costs of the lower liquidation value received by local banks. These firms raise funds on local capital markets even in countries with low financial development.

An example of such a case is presented in Figure 2.3. As in Figure 2.1, parameters are such that there is no FDI with parent debt in the contagion region. Yet, under low financial development, there are some firms which are at risk of contagion with home debt only but able to diversify with parent debt. The risk of a currency crisis creates a wedge between parent finance and local finance at $\gamma^* = \frac{\gamma_L}{L}$, whereas with $\lambda = 0$ both were equivalent at this threshold. As a consequence, a fringe of firms choose local borrowing in less financially developed countries despite their lack of creditor rights, in order to hedge their investment against exchange rate risk.

In sum, multinational firms operating in countries with underdeveloped capital markets and significant foreign exchange risk face an additional tradeoff: local debt carries higher borrowing costs, but protects against the risk of a sharp depreciation of the foreign currency. Its hedging properties raise the attractiveness of local-currency debt.

2.6 *Empirical evidence*

In this section, we present some supporting evidence about the main drivers of capital structure in the model: host country financial development and the correlation of sales across markets.

2.6.1 *Data*

We test our predictions on aggregate data about the activity and financing of US multinational affiliates in 55 countries over the period 1999-2009. The Bureau of Economic Analysis Survey of Direct Investment Abroad provides us with data on the assets and liabilities of majority-owned foreign affiliates of US multinational companies. We construct, for each country-year pair, the shares of US parents and of persons in the affiliate's country of location in "current liabilities and long-term debt" and in total external liabilities. The same source lists total sales of US affiliates in manufacturing sectors by destination. Given our focus on horizontal FDI, we retain affiliate sales to the country in which they are located. In order to calculate the relative shares of exports and affiliate sales serving a foreign market, we use Census data on manufacturing exports from the US, disaggregated by country.

Financial development of host markets γ^* is measured by the ratios of total credit to GDP and private credit to GDP, from International Financial Statistics and Global

Development Finance. As for distance between each country and the US, we use an indicator for whether countries share a border, as well as the bilateral distance from CEPII (Head, Mayer, and Ries, 2010). The latter is a weighted distance measure, where the weights are calculated from city-level data to assess the geographic distribution of population inside each country. This dataset also provides us with indicators of cultural distance. We use common official language and common legal origin indicators, which both render it easier for domestic creditors to deal with foreign claims. Hence, distance, common language and common legal framework are our empirical counterparts to the gap between L and \underline{L} in the model.

Business cycle comovement is derived from GDP data from the World Development Indicators and OECD. For each country, we calculate the correlation of annual GDP growth in local currency with that of the US, over a moving window covering the previous 20 years. Finally, we control for corporate taxation which, although left out of the model, has been shown to affect firms' decisions of where to borrow. Data on the highest marginal corporate tax rate in the host country comes from WDI.

2.6.2 *Some evidence*

We do not test directly Result 2.1, which relates higher firm productivity to a more frequent choice of serving a market through affiliates. A rigorous test of this prediction would require firm-level data to back out productivity levels, and it has already been explored in the literature. Though emphasizing different channels – a trade-off between larger sunk costs and lower transport costs, known as the “proximity-concentration tradeoff” – Helpman, Melitz, and Yeaple (2004) also predict that the most productive firms engage in horizontal FDI. Among US firms present in the COMPUSTAT database, they show that within a sector, labor productivity is higher

for MNEs than non-MNE exporters and firms with no foreign activities. We focus on the other two results, which speak to the core of the model.

Business cycle correlation and affiliate sales

According to our second prediction, multinational firms in less financially developed countries rely more on affiliates, relative to arm's length technology transfer, if the correlation of sales with the home country is larger. More correlated business cycles lower the risk of contagion within the firm, if a bad shock in one country would jeopardize the financial health of the firm as a whole. Since home borrowing prevails among multinationals operating in countries with less developed financial markets, they cannot selectively declare bankruptcy, thereby isolating shocks. Hence, a higher correlation means that there is a lower risk of having to close down healthy plants following bad foreign returns. In turn, it makes in-house production more attractive relative to outside licensing.

This prediction is borne out in the data about US affiliate sales, shown in Table 2.2. The dependent variable is local affiliate sales divided by the sum of local affiliate sales and exports. As we can see, it is positively and significantly associated with the correlation of GDP growth between the United States and the host country. The coefficient is unchanged when we add time fixed effects in columns 3 and 6. These results support the theory that multinational firms are concerned about how a foreign investment adds to their overall riskiness.

We find no significant evidence that the relationship between business cycle correlation and the share of affiliate sales varies with financial development, although the point estimates are negative. As we mentioned above, however, our theoretical predictions are not clear-cut for countries with highly developed credit markets.

Table 2.2: **Share of affiliate sales and business cycle correlation**

	Share of affiliate sales in foreign sales					
	(1)	(2)	(3)	(4)	(5)	(6)
GDP growth correlation	33.092*** [9.728]	46.291*** [15.631]	47.704*** [15.940]	32.220*** [10.112]	42.755** [16.339]	43.865** [16.739]
Credit (% of GDP)	0.045 [0.032]	0.061 [0.042]	0.062 [0.043]			
Private credit (% of GDP)				0.064 [0.049]	0.095 [0.059]	0.098 [0.060]
Credit * Correlation		-0.138 [0.125]	-0.152 [0.129]			
Private credit * Corr.					-0.138 [0.159]	-0.152 [0.164]
Observations	429	429	429	418	418	418
R-squared	0.223	0.236	0.243	0.221	0.229	0.236

Standard errors clustered by country. (3) and (6) include year fixed effects.

Robust standard errors in brackets. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Moreover, compared to the United States, almost all countries in the world have lower financial development, so that the case with low financial development in the host country is most relevant. There is no direct influence either of credit conditions on the choice between affiliate sales and exports.

Parent versus local borrowing

According to Result 2.3, the share of parent financing in affiliates' liabilities, relative to local finance, increases with host country financial development. This prediction is supported in the aggregate behavior of US multinational affiliates. Table 2.3 shows that a higher credit to GDP ratio is associated with a larger share of local borrowing. This finding holds regardless of whether we measure financial development with total credit or private credit. Results on geographical and cultural proximity

Table 2.3: Source of borrowing and local financial development

	Share of parents in affiliate debt					
	(1)	(2)	(3)	(4)	(5)	(6)
Credit (% of GDP)	-0.043*** [0.009]	-0.043*** [0.009]	-0.040*** [0.009]			
Private credit (% of GDP)				-0.044*** [0.016]	-0.052*** [0.018]	-0.048*** [0.018]
Log weighted distance		-1.678 [3.031]	-1.757 [3.110]		-2.557 [2.925]	-2.533 [2.998]
Border		-4.770 [5.193]	-4.516 [5.290]		-6.118 [4.993]	-5.710 [5.081]
Common legal origin		3.177 [2.537]	3.626 [2.771]		4.846* [2.526]	5.108* [2.764]
Common language		-0.560 [2.424]	-1.014 [2.566]		-0.806 [2.309]	-1.173 [2.520]
Corporate tax	0.286** [0.131]	0.274** [0.122]	0.200* [0.114]	0.200 [0.135]	0.177 [0.118]	0.108 [0.113]
Observations	395	395	395	396	396	396
R-squared	0.115	0.133	0.203	0.074	0.111	0.186

Standard errors clustered by country. (3) and (6) include year fixed effects.

Robust standard errors in brackets. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

are more mixed. The coefficients on distance, contiguity and common language are insignificant. There is weak evidence that affiliates in countries which, like the US, have legal systems rooted in British common law rely more on internal debt. This is consistent with our model in which the discount incurred by home creditors when they liquidate foreign assets is lower in more similar countries. Also, consistent with existing empirical evidence, multinational affiliates rely more on parent debt in countries with higher corporate tax rates. This can be attributed to the tax deductibility of interest payments.

Table 2.4 repeats the same exercise with the share of parents in total external

Table 2.4: **Source of external finance and local financial development**

	Share of parents in total affiliate liabilities					
	(1)	(2)	(3)	(4)	(5)	(6)
Credit (% of GDP)	-0.065*** [0.012]	-0.069*** [0.013]	-0.064*** [0.013]			
Private credit (% of GDP)				-0.079*** [0.019]	-0.091*** [0.019]	-0.087*** [0.019]
Log weighted distance		1.928 [3.716]	1.784 [3.788]		0.656 [3.736]	0.663 [3.786]
Border		4.627 [5.347]	4.896 [5.438]		2.706 [5.391]	3.204 [5.463]
Common legal origin		2.495 [5.197]	3.161 [5.401]		5.389 [5.217]	5.824 [5.375]
Common language		-2.624 [5.082]	-3.107 [5.261]		-3.000 [4.933]	-3.346 [5.105]
Corporate tax	0.410** [0.174]	0.391** [0.177]	0.284 [0.173]	0.284 [0.171]	0.235 [0.166]	0.134 [0.163]
Observations	401	401	401	402	402	402
R-squared	0.167	0.179	0.263	0.141	0.164	0.257

Standard errors clustered by country. (3) and (6) include year fixed effects.

Robust standard errors in brackets. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

liabilities instead of their share in total external debt. It shows, similarly, that a larger share of affiliate financing is raised in local capital markets when the host country is more financially developed.

2.7 Conclusion

In this paper, we have shed light on the role of financial frictions in the decisions of multinational firms, in particular the choice of whether to raise external finance on local markets or rely on parent funding. When firms face imperfect credit markets, taking into account the risk of financial distress at the level of the multinational

firm can help us understand the decision of whether to open foreign affiliates, as opposed to arm's length technology transfer, and how to finance their investment. The only motive for integration we have stressed is to take advantage of internal capital markets. MNEs can borrow at the lowest available rates and share risks from demand-side shocks across geographical divisions. The downsides are the potential transmission of bad shocks within the firm, as well as the lack of information of home banks about foreign projects. This framework predicts that only the most productive firms are able to reap the diversification benefits of multinational activity, and that they rely more on host country debt in more developed financial markets. Moreover, the synchronization of business cycles plays an important role. In countries with underdeveloped credit markets, a high correlation of sales between the home and host markets encourages multinational activity, as it lowers the risk that bad returns in one entity will force the firm to liquidate more profitable divisions. This last prediction is specific to the financial frictions channel behind the choice of local debt versus parent debt, as opposed to a contractual frictions channel which has been previously uncovered in the literature.

This paper could be extended in several directions. First, we could generalize the model to a multicountry framework, in which the parent firm would take into account how each location adds to its overall financing mix and bankruptcy risk. It could also be extended to an infinite horizon setting to study the role of retained earnings in alleviating credit constraints. Second, at the industry level, the ability of parent firms to use home and host credit markets opportunistically differentiates MNE subsidiaries from local firms. It would be interesting to study more precisely how finance acts as a source of competitive advantage for multinational affiliates over local firms. In particular, we would expect that investment of MNE subsidiaries would be less affected by

a local credit crunch than that of similar local enterprises, but may be more affected by a global credit crunch. Third, we could refine the empirical analysis much further by using firm-level data on affiliate assets and liabilities. Analyzing stock return data on multinational companies would also allow us to find out whether geographical diversification carries a premium or a discount depending on which markets the firm is active in. These topics are left for future research.

3. EDUCATION AND MILITARY RIVALRY¹

3.1 *Introduction*

What makes countries engage in mass education investments? A common view is that such investments are the flipside of democratic transitions (see e.g., Bourguignon and Verdier, 2000). Absent democracy, the elite chooses to deny mass access to education in order to secure its power, while the introduction of democracy – extending the franchise, increasing electoral competition, or putting tighter constraints on the executive – promotes decisions that favor mass education. This explanation might look quite convincing, and seemingly accounts for the history of education enrollment in Europe starting with France. Indeed, Figure 3.1 (drawn from Lindert, 2004), suggests that public contributions to primary-school education went up sharply in 1880, once France had completed its transition from the Second Empire to the Third Republic, which clearly reflected a move towards greater democracy².

However, another event that precipitated the fall of the Second Empire is France’s defeat against Germany in the 1870 Battle of Sedan. In the words of Lindert

“The resounding defeat by Prussia tipped the scales in favor of the education reformers. Enrollments and expenditures accelerated across the

¹ Joint with Philippe Aghion, Harvard University, and Torsten Persson, IIES (Stockholm University). We thank Xavier Jaravel for superb research assistance.

² The complementary view that education favors democracy is analyzed, in particular, by Glaeser, Ponzetto, and Shleifer (2007).

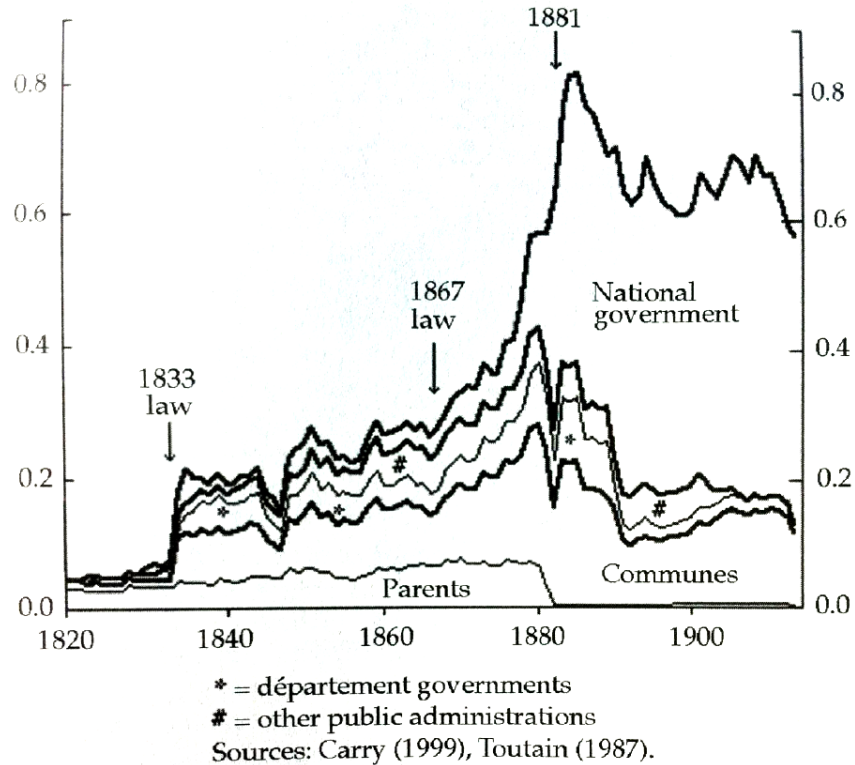


Figure 3.1: Shares in financial contributions to primary education in France

1870s, with local taxation leading the way. The real victory of universal tax-based education came with Jules Ferry's Laic Laws of the 1880s, especially the 1881 law abolishing all fees and tuitions charges in public elementary schools. [...] While national politics could not deliver a centralized victory for universal schooling before the military defeat of 1870 [...] after 1881 centralization performed the mopping up role." (Lindert, 2004, p. 112)

One reason why a military defeat may spur centralized investment in mass education is suggested in the work of Eugene Weber on the modernization of rural France between 1870 and 1914 (Weber, 1979). A highly disintegrated population, largely il-

literate, speaking a multiplicity of dialects, and with no sense of nationhood³, was to be transformed into a unified people sharing the same patriotic values, a spoken and written language, a set of moral principles, and a motivation and ability to defend France in future conflicts⁴.

In this paper, we study historical panel data on education spending and enrollment – for Europe and Latin America since the 19th century and a larger set of countries in the postwar period – to assess the correlation between military rivalry or war risk and primary education enrollment (or the occurrence of educational reforms). First, we perform standard OLS regressions and find that, conditional on country and year fixed effects, mass education is positively and significantly associated with military rivalry, and with involvement in an external war in the previous 10 years. Moreover, while the coefficient on democracy (gauged by the Polity IV index) comes out negative when we control for military rivalry, the interaction between the two variables is often positively and significantly associated with mass education. The coefficient on military rivalry remains stable when we control for the political regime, suggesting that military threats have a stable and independent influence on mass education.

To deal with appropriate concerns about endogeneity, we then instrument military rivalry in two different ways. Our first instrument uses data on commodity prices. The idea is that high prices of natural resources or agricultural commodities are likely to foster rivalries, as states are tempted to compete for the control of more valuable resources. Our second instrument uses rivalries with third countries of those

³ As a French novelist of that time would put it “In Velay, the word “patrie” signifies nothing and stirs nothing. It exists no more in local speech than in local hearts”.

⁴ As Leon Gambetta would say to the leader of the Breton forces: “I beg you to forget that you are Bretons, and to remember only that you are French”.

countries with which a certain country shares a border. The idea here is to capture when military rivalries are rife in a country's neighborhood. The corresponding IV specifications show a positive and significant effect of rivalry on primary enrollment, a negative direct effect of democracy, and (for the second instrument) a positive and significant interaction term between the two. Overall, our empirical results indicate a causal relationship from rivalry to primary educational enrollment.

Our paper relates to, at least, three literatures. As for the relationship between public education investment and democracy, Lott (1999) suggests that non-democracies could invest more than democracies in public education as a means of indoctrination. On the other hand, Glaeser, Ponzetto, and Shleifer (2007) argue that education and democracy should be positively correlated, due to the need for civic participation to raise support for transitions from dictatorship into democracy. But the evidence for a positive relationship between education spending or enrollment and democracy is mixed, at best. In particular, Mulligan, Sala-i Martin, and Gil (2004) present cross-country evidence indicating that more democratic political institutions do not seem to correlate with higher levels of social expenditures and, in particular, higher public education spending. More recently, Bursztyn (2011) shows that poor voters in Brazil might prefer the government to allocate resources to redistributive policies, yielding immediate income increases (such as cash transfers), instead of allocating resources to public primary education. Also related to our analysis is the work by Bourguignon and Verdier (2000), who develop a model to explain why the ruling class may sometimes decide to invest in education even though schooling enhances political participation. Along similar lines, Galor and Moav (2006) argue that capital accumulation gradually intensifies the importance of skilled labor in production and therefore generates support among the ruling class for investing more in human

capital. Galor, Moav, and Vollrath (2009) argue that a higher concentration of land ownership typically discourages the development of human capital enhancing institutions, in particular schooling. However, none of these papers looks at the effect of military threats in democracies and autocracies.

A second related literature deals with the economic and political impact of wars. On the latter, Ticchi and Vindigni (2009) analyze theoretically a mechanism whereby international conflict may trigger democratic transitions, motivated by a large amount of earlier research in political science and political sociology, such as Giddens (1985), and empirical facts presented by Dolman (2004). Another literature on the economic impact of wars starts with Anderton and Carter (2001), Blomberg and Hess (2006), and Glick and Taylor (2005). More recent work by Martin, Mayer, and Thoenig (2008a,b) and by Acemoglu and Yared (2010) evaluates the extent to which wars reduce trade flows. This research does not generally investigate the links between wars and investment in education, though.

A third related literature deals with fiscal capacity and state capacity more generally. Hintze (1975) and Tilly (1975), preceding many others, provide historical accounts on the importance of wars for state building. More recently, an economic literature summarized in Besley and Persson (2011) considers theoretically investments in fiscal and legal capacity, and finds robust correlations between past wars and current state capacity in international panel data. Thies (2004), using the same measure of strategic rivalry as we do, shows that military rivalry raises fiscal capacity in postcolonial developing states. Scheve and Stasavage (2011) investigate the links between wars, democracy, and estate taxation in about 20 countries since 1816 and find that democracy does not have a systematic influence on top rates of estate taxation, whereas wars with mass mobilizations do significantly raise these rates. Anal-

ogously, we find support for a correlation between past wars – and military rivalry more generally – and current educational investments, while (in parallel to Scheve and Stasavage), the correlation between wars and democracy is more tenuous. In addition, we find that the effect of military rivalry on educational investment is larger in democracies, something possibly quite specific to education. Also, in contrast to this literature, we treat state capacity as exogenous, both in the theory part and in our empirical analysis.

The paper is organized as follows. In Section 3.2, we describe three historical examples that speak to the relationship between military rivalry and education reforms. We also show that in nearly all countries for which we have long enough time series, periods with large hikes in primary enrollment are preceded by wars rather than by transitions to democracy. Section 3.3 presents our data, descriptive statistics, and empirical specification. In Section 3.4, we describe the econometric results and discuss their robustness to a variety of factual and statistical concerns. In Section 3.5, we lay out a simple model that rationalizes our main empirical findings. Section 3.6 concludes.

3.2 *Lessons from history*

While each national history has unique elements that cannot be forced into a unified framework, the examples of France, Japan, and Prussia over the 19th century all suggest a relationship between military defeats or rivalry and educational reforms. Prussia led the way in terms of primary enrollment rates in Europe from 1815 until about 1860. In the 1880s, France overtook Prussia as the European enrollment leader. In addition we look at Japan, a leading Asian country at the end of the 19th century, which ended up emulating the Prussian and French models in its own transition to

mass education. For each of these examples, we describe the historical context, the debate that emerged due to a volatile international environment, and the subsequent education reforms with a particular focus on primary enrollment.

3.2.1 Prussia under Stein and Humboldt

Background

As late as 1803, Prussian King Frederick William III would declare:

“the children of this hardworking Volksklasse should not become lecturers, not chancellery officials, not mathematicians, not religion professors. They should learn to read their catechism, Bible, and hymnal, to write and calculate in accordance to their limited circumstances, to love and fear God and behave accordingly” (Lindert, 2004).

However, after the humiliating defeat to Napoleon I in Jena in 1806, which took the Hohenzollern Monarchy by surprise, the King asked Baron Karl von Stein to head a new ministry devoted to the improvement of Prussian institutions and infrastructures “to make Prussia as vital and as strong as France”.

The reform process

Stein did not originally pay much attention to education. His primary focus was on the organization and administration of the Prussian state. But he understood the importance of promoting patriotism among the population – he first tried to do so through a city governance reform, in the hope that the participation of the community in its own affairs would create a civic sense. Stein realized that his major reforms, namely the end of villeinage, the reform of the army, and the self-administration

of the towns, could be unsuccessful due to the insufficient level of education. He thought that Wilhelm von Humboldt would be capable of bringing about a complete reform of the Prussian education system and called him to Berlin. Thus, on February 28, 1809, von Humboldt became head of the culture and education section at the Ministry of the Interior, although Stein had left office by then. Napoleon had called for his dismissal and the King of Prussia had agreed to that request.

“From the beginning of the crisis, even prior to the startling defeats of Jena and Auerstadt, two views were competing in government circles about the future direction of Prussia” (Gray, 1986, p. 47)

A “peace party” was organized around von Haugwitz and Lombard, while the “patriots” followed Stein and von Hardenberg. Von Humboldt endorsed the ideals defended by Stein, who had said that

“the chief idea was to arouse a moral, religious and patriotic spirit in the nation, to instill into it again courage, confidence, readiness for every sacrifice in behalf of independence from foreigners and for the national honor, and to seize the first favorable opportunity to begin the bloody and hazardous struggle” (Ford, 1965, p. 122).

Humboldt sensed that his reforms could play a key role in the survival of Prussia. He had developed his ideas in the 1809 treatise *Über Die Mit Dem Königsberger Schulwesen Vorzunehmende Reformen* (On reforms to execute with the teaching in Königsberg) and was able to initiate fundamental reforms of curricula, teaching methods, teacher education, and auditing in the school system. His reforms delegated the powers to administer and fund schools to local communities in order to circumvent the surveillance of the French. They also helped found Berlin University. However, his percep-

tion of insufficient support for his plan to reform educational administration under the current government led Humboldt to present his resignation to the King in the spring of 1810.

After the defeat of Napoleon in 1815 to a coalition of European powers, the immediate external threat to Prussia was removed and the Prussian government stopped endorsing the ideal of reform. Yet, “once the reformed Prussian educational framework was in place, it could not be dislodged by the subsequent waves of conservatism” (Lindert, 2004), because von Humboldt had set up a decentralized education system. In 1876, funds from the Prussian state accounted for only 9% of the budgets of public primary schools, endowments for 3%, fees for 15%, and the remaining 73% came from local taxes. Throughout the 19th century, the provision of local education in German communities kept increasing, and Prussia eventually became the leader in primary enrollment. In this respect, von Humboldt’s reforms had lasting consequences. It is also interesting to note that Stein encouraged democratization of towns to gain the support of the population. This may suggest that the probability of successful educational reform is higher in democracies.

The outcomes

The educational reforms in Prussia had a substantial long-run impact. Of the cohorts born in Prussia before 1801, 16.8% of males were completely illiterate, as against 2.9% for males born between 1837 and 1841 (Block, 1995). The literacy rate inched up towards 85% in 1850 and Prussia became the European leader with regard to primary enrollment until the 1880s. The primary school enrollment per 10,000 inhabitants⁵ rose from 1,131 in 1815 to 1,592 in 1850.

⁵ School02 variable from the CNTS data archive (Banks, 2011).

3.2.2 *Jules Ferry's France*

Background

In 1870, French public expenditures on education were lagging behind that of Prussia and other European countries. The French education system was mainly private, largely revolving around churches. Teaching was done by priests or more casually by anyone around who knew how to read. Classrooms were often improvised in the backyard of a farm, with poor equipment and amenities. And a high fraction of registered children never attended school. The result was that a large share of the population was either illiterate or unable to understand the content of a text. In 1863, 7.5 million citizens (about a fifth of the French population) could not even speak French properly but only local dialects.

Even prior to the war with Prussia in 1870, French elites were aware of the fact that the French education system had failed to promote national unity. Victor Duruy, appointed Minister of Education in 1863 by Napoleon III, was already advocating sweeping educational reforms, the improvement of educational facilities, and the development of technical education. His plans were in many ways similar to those that Jules Ferry would pursue some 20 years later⁶. Duruy tried to gather political support and convince the Emperor that it was in his own interest to implement such a reform. But he did not succeed, partly due to a lack of support from a rural population influenced by the Church⁷.

⁶ "Duruy's major objective was to make primary education compulsory and tuition free so that each citizen could fulfill his duties under universal suffrage and contribute to the burgeoning economy" (Moody, 1978, p. 72).

⁷ "In a letter to the Emperor on 6 February 1866, [Duruy] maintained that his plan would embarrass the Orleanists, the clericals and the republicans, and win millions of families to the Empire, particularly the parents of the million and a half pupils who were now accepted free, but under the stigma of charity" (Moody, p. 72). In fact, Duruy never managed to reduce the hostility of the rural masses, who

The turning point was the French defeat against Prussia in 1870. On September 2, 1870, Napoleon III was made prisoner at Sedan, and on February 26, 1871, Germany took control of the French regions of Alsace and Lorraine. This resounding defeat prompted the fall of the Second Empire and helped trigger the subsequent educational reforms by leaders of the Third Republic.

The reform process

After the Sedan defeat, the debate would continue between conservative forces opposing and progressive forces supporting educational reforms, even though the balance of power had shifted towards the latter. While the conservatives led by the Church would see Sedan as a punishment for France's infidelity to its old (monarchical) traditions, the progressives saw Sedan as a reflection of the superiority of Prussian schools and university system⁸. Overall, even though groups and political parties would still disagree on the causes of military defeat, a majority of them agreed that education in Prussia had played a key role in the rise of this new power, and that education in France had to be reformed, not only to increase literacy, but also to ac-

looked on farm labor as a natural apprenticeship, and consequently Napoleon decided to let the project of his minister be defeated by the legislature.

⁸ "Unexpected defeat, occupation, and sanguinary civil war fixed 1870-71 in the French consciousness as 'the terrible year.' Several national myths were deposed, end of the vision of national glory built during the Second Empire. [...] Frenchmen who had lived through the experience were aware that defeat had exacerbated the social and political divisions of the nation – the Commune provided brutal evidence. But intellectual disagreements were also sharpened as Frenchmen sought for a cause of the disasters that had befallen them. [...] There was a debate about the source of the defeat: the prime culprit was the Empire and all its works. The right viewed Sedan as deserved punishment for infidelity to the traditions of France. Toward the Church there was an initial ambivalence. Most people thought that 'France had neglected intellectual formation, particularly in the sciences [...].' There was nearly universal belief among the French elite that Prussia had triumphed because of the superiority of its celebrated universities: a popular aphorism was that the University of Berlin was the revenge for the defeat at Iena. French praise for German education extended to all levels of the system. Journalists repeated the dicta that the Prussian elementary school teacher was the architect of Sedan and that the modern secondary education of the Realschulen had provided the scientific base for Prussian military efficiency." (Moody, p. 87).

quaint new generations with basic knowledge in arithmetics, history and geography, and to

“teach Frenchmen to be confident of their nation’s superiority in law, civilization and republican institutions. It should be consistent with reigning social values, and thereby eliminate disruptive conflicts and promote the unity of the classes. Since France no longer enjoyed religious unity, it must forge a new moral unity from a unified education that would teach civic morality based on the principles of natural reason” (Moody, 1978, p. 88).

Jules Ferry was appointed as the new Minister of Education in February 1879. In 1881, he abolished all tuitions fees in public elementary schools; in 1882, he made school enrollment compulsory from age six to thirteen; in 1883, it became compulsory for every village with more than twenty children at school age to host a public elementary school; in 1885, subsidies were devoted to the building and maintenance of schools and to paying teachers; and in 1886, an elementary teaching program was established, together with monitoring provisions. These are the so-called “Laic Laws”, which still characterize the French educational system today. At the same time, a whole infrastructure program – the Freycinet plan – was initiated to facilitate children’s access to schools. Millions of francs were spent on building roads to match the large amounts spent on schools: 17,320 new schools had to be built, 5,428 schools were enlarged, 8,381 schools were repaired (Weber, 1979). As a result, enrollment as well as attendance in primary education steadily increased.

The reforms not only generalized the access to schooling, but also transformed the content of elementary education: new programs emphasized geography, history, and dictation. The new teaching programs in history and geography aimed at conveying patriotic values to new generations. As for dictations, they were useful to teach

people the French language but, beyond that

“the exercise was a sort of catechism designed to teach the child that it was his duty to defend the fatherland, to shed his blood or die for the commonwealth, to obey the government, to perform military service, to work, learn, pay taxes and so on” (Lindert, 2004, p. 333).

From their very first day at school, children were taught that their first duty was to defend the fatherland. Even gymnastics were meant “to develop in the child the idea of discipline, and prepare him [. . .] to be a good soldier and a good Frenchman.”

Outcomes

Official statistics attest that school attendance rose appreciably in the decade after 1882. Primary enrollment rates went up from 1,176 per 10,000 inhabitants in 1870 to 1,430 in 1912. Literacy rates rose from 80% in 1870 to 96% in 1912 (and the initial 80% figure is partly misleading, as most supposedly literate children did not understand the content of what they read prior to the reforms). Finally, the reforms appear to have increased the sense of patriotism and national unity. Thanks to the Ferry laws,

“in Ain, Ardennes, Vendee, all children became familiar with references or identities that could thereafter be used by the authorities, the press, and the politicians to appeal to them as a single body” (Lindert, 2004, p. 337),

and in that respect Ferry’s efforts paid off during the subsequent mobilization in 1914.

3.2.3 *Japan in the Meiji Era*

Background

From the 17th century, Japan was ruled by military lords (the so-called *shoguns*) of the Tokugawa dynasty. Under the Tokugawa, education was a privilege of the Samurais and centered on tradition and the study of Confucian classics. However, starting in the mid 1850s, Japan came under threats by Western powers. In 1853, Commodore Matthew Perry arrived in Japan from the United States with an ultimatum to the authorities: agree to trade or suffer the consequences of war. To add credibility to this threat, American warships were sent to Japan in 1854. Subsequently, the Trade Convention of Kanagawa was signed on 31 March, 1854. The threats posed to Japan by Western powers in the second half of the 19th century acted as a catalyst for educational reforms. As put by Duke:

“In 1872, government leaders were haunted by a crisis of international proportions. Powerful western nations were expanding trading posts throughout the world. European colonial empires had spread into the Far East, threatening the very existence of Japan as a sovereign state. During the years of self-imposed isolation by the Tokugawa regime from the early 1600s, the country had fallen dangerously behind the West as the industrial revolution got under way. The rise of western capitalism and international colonialism posed a pervasive threat to Japan, as perceived by the new leaders. They were determined to use any means necessary to transform their country into a modern state in order to preserve the political order and the national sovereignty. Education on the Western model was envisioned as an instrument to achieve that goal.” (Duke, 2009, p. 1).

The Tokugawa implemented various reforms at the beginning of the 1860s, but did not go far enough to satisfy the Samurais. As a result, Japan fell into civil war. In early January 1868, the insurgents prompted the Emperor Meiji, who had just taken the throne, to announce an “imperial restoration,” which in fact was nothing less than a coup d’Etat.

The reform process

The education debate featured the opposition between those who wanted to preserve the focus on Confucian classics and maintain interpersonal hierarchical relationships, and those who wanted to introduce secular Western science with more mathematical thinking to catch up with Western technology. This debate fed a broader political crisis, culminating with the civil war. Following the imperial restoration, Western-oriented progressives eventually prevailed over Eastern-oriented traditionalists. The newly founded Ministry of Education sent delegates to the West to learn about their education system, for instance with the Iwakura mission of 1872-1873.

To rise up to the challenges posed by the West, in 1872, a new education system was instituted which declared four years of compulsory elementary education for all children. As explained by Burnett and Wada (2007),

“in just a one-year period following the Gakusei of 1872, 12,500 primary schools were established. Within the next five years the number of schools doubled to a figure not surpassed until the 1960s.”

The move to mass education was completed by a national training system for teachers. The first teacher’s college was created in Tokyo in July 1872, based on American principles of elementary-school instruction.

Outcomes

Initially, reactions to the educational reform were mixed.

“Not everyone was so happy at the obligation to attend school and the opportunity to graduate. The elementary schools were to be financed by a 10 percent local surcharge to the national property tax. In the 1870s, angry taxpayers reacted to compulsory schooling as they had to the draft: they rioted. Crowds of people destroyed at least two thousand schools, usually by setting them afire. This represented close to one-tenth of the total number of schools. The passive resistance of simply not going to school was even more widespread. Rates of attendance for school-age boys and girls stood at 25 to 50 percent of the eligible population for the first decade of the new system” (Gordon, 2000, p. 68).

One might argue that popular resistance to the educational reforms reflected a lack of democracy in the Japanese system – the peasants did not identify with the emperor, nor with the new ruling class, and therefore disapproved of the nationalistic education that was now compulsory. Similarly, people at first tried to resist the military reform.

Yet, over time, the Japanese educational reforms appeared more and more as a resounding success. Japan overtook most European powers with regard to primary enrollment per school-age child, which rose from 28.1% in 1873 to 98.1% in 1910. From 1865 to 1910, the literacy rate increased from 35% to 75% for men and from 8% to 68% for women. The primary school enrollment per 10,000 inhabitants rose with blistering speed, from 65 in 1876 to 1,122 in 1905.

The success of education reforms certainly played a role in the unexpected military victories by Japan in the 1895 war against China and the 1905 war against Russia. Overall, Japan's educational reforms during the Meiji era further illustrate the idea that education reform occur as a result of strategic military concerns. The Japanese example is probably even clearer than the French one, in that the military considerations clearly took precedence over humanist ones. The popular resistance to the reforms may reflect the fact that a lack of democracy reduces the effectiveness of educational reforms.

3.2.4 *Taking stock*

Figure 3.2 summarizes our historical overview of educational reforms in Prussia, France and Japan. In all three cases, military defeats and/or perceived military threats appear to have prompted an otherwise reluctant ruling class to invest in mass primary education.

Let us also take a less detailed bird's-eye view on historical evidence from the large sample (of 137 countries) that we use for econometric estimation in the next section. We restrict attention to 53 countries within that sample for which more than forty years of primary enrollment data are available. For each of these countries, we first identify the twenty-year period during which primary enrollment rose most sharply – we call this the “educational reform period”⁹). We then look at the preceding twenty years to see whether a war or a democratic transition took place during that period.

⁹ The educational reform period in Table 3.1 is defined as the period during which the change in primary enrollment rate was the greatest *in percentage terms*, not in absolute value.

Country	Period	External Threat	New Policies	Key Figures	Outcome
Prussia	1810s	Defeat of Iena in 1806	<ol style="list-style-type: none"> 1. Reforms of curricula, teaching methods and teacher education 2. Delegating power to local communities regarding administration and funding of schools 3. Foundation of Berlin University 	Wilhelm von Humboldt Baron vom Stein	<ol style="list-style-type: none"> 1. Failure in the short run due to the opposition of the French 2. Substantial impact in the long run: <ul style="list-style-type: none"> - 16.6% of males born in Prussia before 1801 were completely illiterate, as against 2.9% for males born between 1837 and 1841⁹ - starting in the 1810s, literacy rates gradually increased and reached 85% in 1850³ - Prussia became the leader for primary enrollment until the 1880s⁴ - schools remained funded primarily by local taxes throughout the 19th century⁴ 3. Primary school enrollment per 10,000 people: 1131 in 1815 vs. 1592 in 1850^{5,11}
France	1880s	Franco-Prussian War of 1870	<ol style="list-style-type: none"> 1. Abolition of all fees and tuition charges in public elementary schools 2. Education is made compulsory until age 13 3. Religious education in public school is forbidden 4. 17,320 new schools are built, 5,428 enlarged, 8,381 repaired¹ 5. The new curriculum promotes patriotism 	Jules Ferry	<ol style="list-style-type: none"> 1. France overtook Prussia as the leader for primary enrollment in the 1880s⁴ 2. Literacy rates quickly increased from 80% in 1870 to 96% in 1912⁸ 3. Increased sense of patriotism and unity¹ 4. Primary school enrollment per 10,000 people: 1176 in 1870 vs. 1430 in 1912^{5,11}
Japan	1870s	Risk of colonization by Western powers	<ol style="list-style-type: none"> 1. Introduction of modern science in the curriculum 2. Elementary education is made compulsory 3. 25,000 new schools are built² 	Mori Arinori Yamagata Aritomo	<ol style="list-style-type: none"> 1. Strong popular resistance in early stages 2. Resounding success in a few decades: <ul style="list-style-type: none"> - Japan overtook most European powers in terms of primary enrollment, which rose from 28.1% in 1873 to 88.1% in 1910⁷ - from 1865 to 1910, the literacy rate increased from 35% to 75% for men and from 8% to 68% for women⁷ - traditionalists and progressives agreed on the curriculum planned by the 1890 Imperial Rescript⁸ 3. Primary school enrollment per 10,000 people: 65 in 1876 vs. 1122 in 1905^{5,11}

References

1. Weber, E (1979), *Peasants into Frenchmen: The Modernization of Rural France, 1870-1914*, Chatto & Windus.
2. Burnett, J, and Wada, Y (2007), "The Ebb and Flow of Japanese Educational Reform", *Australian Association for Research in Education*.
3. Arno, Robert F., and Harvey J. Graff (2006), *National Literacy Campaigns and Movements: Historical and Comparative Perspectives*, Transaction Publishers.
4. Lindert, P (2004), *Growing Public: Social Spending and Economic Growth since The Eighteenth Century*, Cambridge University Press.
5. CNTS Data Archive.
6. Morrisson, C, and Murtin, F (2009), "The Century of Education", *PSE Working Paper no.2009-22*.
7. Taira, Koji (1971), "Education and literacy in Meiji Japan: An Interpretation", *Explorations in Economic History*, vol. 8, issue 4, pages 371-384.
8. Duke, B (2008), *The History of Modern Japanese Education: Constructing the National School System (1872-1890)*, Rutgers University Press.
9. Block, Rainer (1995), *Der Alphabetisierungsverlauf im Preussen des 19. Jahrhunderts: Quantitative Explorationen aus bildungshistorischer Perspektive*, European University Studies (Series XI, Education).

** Note that, in the long run, primary school enrollment per capita depends on the primary school enrollment rate of new generations but also on the evolution of the demographic structure of the country.

Figure 3.2: Summary of external threats and education reforms in Prussia, France and Japan

We use the *polity2* index from the Polity IV database¹⁰ and define a democratic transition as occurring when the *polity2* variable moves from the “anocracy” to the “democracy” range, i.e. when crossing the score of 6 (at a scale from -10 to 10) from below. We identify external wars from the Correlates of War dataset¹¹ and military rivalry data are drawn from Thompson (2001). These two datasets are described in more details in the next section.

Table 3.1 summarizes our findings. The first column indicates the educational reform period, the second whether or not a war occurred during the preceding twenty years, while the third indicates whether a democratic transition occurred in the preceding twenty years.

The table shows clearly that in most countries of the sample a war precedes the educational reform, while a democratic transition rarely occurs in the pre-reform period. Among the 53 countries in this table, it is only in two countries where a democratic transition occurs before the rise in education. Most often, the democratic transition instead takes place *after* the educational reform period¹².

However, in several countries in this sample the sharpest increase in primary enrollment took place after the first or the second World War, and the degree of involvement in either of those wars varied a great deal across countries. More generally, the table by no means shows any causal evidence. Also, our identification of the “educational reform” is very crude and may miss important changes in the education system. For example, in the case of France as well as Germany, the greatest increase

¹⁰ <http://www.systemicpeace.org/polity/polity4.htm>.

¹¹ <http://www.correlatesofwar.org/>

¹² See Appendix C.2 for details about the dates of wars and democratization, as well as the availability of data on primary enrollment per country.

Table 3.1: Education surge, democratization and wars: 53 countries

Country	Greatest increase in primary enrollment	Democratization in preceding 20 years?	War in preceding 20 years?
Afghanistan	1946-1966	No	Yes
Albania	1934-1954	No	Yes
Argentina	1889-1919	No	Yes
Belgium	1889-1919	No	No
Bolivia	1882-1902	No	Yes
Brazil	1946-1966	No	Yes
Bulgaria	1889-1909	No	Yes
Canada	1946-1966	No	Yes
Chile	1893-1913	No	Yes
China	1938-1958	No	Yes
Columbia	1893-1913	No	No
Costa Rica	1946-1966	No	Yes
Cuba	1954-1974	No	Yes
Czechoslovakia	1943-1963	No	No data
Denmark	1882-1902	No	Yes
Dominican Republic	1900-1920	No	No data
Ecuador	1946-1966	No	Yes
Finland	1919-1939	Yes	Yes
France	1827-1847	No	Yes
Germany	1867-1887	No	Yes
Greece	1913-1933	No	Yes
Guatemala	1947-1967	No	Yes
Haiti	1907-1927	No	Yes
Honduras	1946-1966	No	Yes
Hungary	1926-1946	No	Yes
Iran	1889-1909	No	No
Ireland	1946-1966	No	Yes
Italy	1889-1919	No	Yes
Japan	1867-1887	No	Yes
Liberia	1946-1966	No	Yes
Luxembourg	1926-1946	No data	Yes
Mexico	1919-1939	No	Yes
Mongolia	1930-1950	No	Yes
Netherlands	1899-1919	No	Yes

Table 3.1: Education surge, democratization and wars: 53 countries (continued)

Country	Greatest increase in primary enrollment	Democratization in preceding 20 years?	War in preceding 20 years?
New Zealand	1946-1966	No	Yes
Nicaragua	1939-1959	No	No data
Norway	1960-1980	No	Yes
Panama	1906-1926	No	Yes
Paraguay	1882-1902	No	Yes
Peru	1930-1950	No	Yes
Poland	1946-1966	No	Yes
Portugal	1854-1874	No	No data
Romania	1893-1913	No	No
Spain	1919-1939	Yes	Yes
Sweden	1939-1959	No	No
Switzerland	1939-1959	No	No
Thailand	1919-1939	No	Yes
Turkey	1886-1906	No	Yes
United Kingdom	1860-1880	No	Yes
United States	1860-1880	No	Yes
Uruguay	1946-1966	No	Yes
Venezuela	1919-1939	No	Yes
Yugoslavia	1930-1950	No	Yes

in primary enrollment does not coincide with the reform periods pinpointed in the historical case studies above¹³. Yet, this crude measure of educational reform hints at the possibility that wars, and more generally military threats, play a more important a role than democratic transitions in promoting broad access to education.

Subsections 3.2.1-3.2.3 presented case-study evidence about wars or military threats leading to educational reforms for Prussia, France and Japan. Subsection 3.2.4 presented cruder but broader historical evidence suggesting that wars or military rivalry

¹³ In France, measured literacy rates were already high prior by 1870. Yet the Jules Ferry reforms of the 1880s raised the average educational level of the French population to a considerable extent compared to what it was before 1880.

are likely drivers of educational reform, while democracy may not be. In the next section, we turn to a more systematic empirical analysis of the relationship between primary enrollment, military wars or rivalry, and democracy.

3.3 *Data and specifications*

3.3.1 *Sources and variable definitions*

Education

To investigate the determinants of mass education reforms empirically, we use an unbalanced panel with annual data for 137 countries between 1830 and 2001. Our main dependent variable, *enrollment*, measures primary enrollment per capita. It is defined according to the UNESCO criteria and expressed per 10,000 inhabitants. The underlying data are drawn from the CNTS Data Archive of Banks (2011). In a first set of regressions, we use primary enrollment as a continuous dependent variable. Since it is constructed as enrollment per capita, rather than enrollment per school-age child, this measure is affected by shifts in the demographic structure of the population. We therefore control for population growth in the previous 10 years to mitigate this concern.

We also analyze the probability of education reforms, where reform is defined in two alternative ways. For the complete sample of countries, a binary *imputed reform* variable is set equal to one in a given year if primary enrollment grew by more than 10% over the previous 5-year period. When we perform the analysis of imputed reforms, we collapse the data into five-year averages so as to minimize measurement error. For a reduced sample of 14 European countries (over the period 1830 to 1975), a binary *known reform* variable is set equal to one in years when new education reforms

were adopted. The latter entail any new law which extends compulsory education, lowers the cost of education (e.g., abolish school fees, provide for free primary education), or increases the number of schools (e.g., by making it compulsory for each municipality to set up at least one primary school). The source for this variable is Flora and Alber (1983).

War threats

We measure war risk and vulnerability to military threats in two alternative ways. Recent experience of external war is likely to raise the perceived likelihood of a new conflict and the salience of military concerns in policy decisions. Hence, our first variable *war risk* is a binary indicator set equal to one if the country was engaged in an interstate war in the previous 10 years, according to the variable "inter-state war" in the Correlates of War (COW) database. This database also provides information on the outcome (victory or defeat) of past wars and a measure of the number of casualties as a percentage of the pre-war population.

This measure of war risk is, of course, completely backward-looking and may therefore miss emerging threats without a history of war. Our second measure, *military rivalry*, is less subject to this concern. Here, we define a dummy variable for whether a country has a strategic rival in a given year according to Thompson (2001). Thompson's measure captures the risk of armed conflict with a country of significant relative size and military strength. It is based on contemporary perceptions by political decision-makers, gathered through the investigation of historical sources on foreign policy and diplomacy. Specifically, military rivalries are identified by three criteria: whether two countries regard each other as "(a) competitors¹⁴; (b) a source

¹⁴ "Most states are not viewed as competitors—that is, capable of "playing" in the same league. Rel-

of actual or latent threats that pose some possibility of becoming militarized; (c) enemies” (see Appendix C.1 for details). We also create a measure of the relative strength of rivals, assessing the probability of winning or losing a potential military conflict, by gauging the ratio of their respective army sizes. To this end, we draw military personnel numbers from the COW National Material Capabilities database.

Political regimes

The political regime is constructed from the institutionalized autocracy and democracy scores in the Polity IV database (*polity2* variable), which are themselves combinations of constraints on the executive, the openness and competitiveness of executive recruitment, and the competitiveness of political participation. The combined score *democracy* ranges from -10 to +10, where a higher score means that the country is more democratic in the year considered.

Covariates

Finally, our regressions include several control variables. Military expenditure and total population are drawn from the COW National Material Capabilities. Fiscal capacity is proxied by a dummy variable equal to one whenever the country has

actively weak states are usually capable of interacting competitively only with states in their immediate neighborhood, thereby winnowing the playing field dramatically. Stronger actors may move into the neighborhood in threatening ways but without necessarily being perceived, or without perceiving themselves, as genuine competitors. If an opponent is too strong to be opposed unilaterally, assistance may be sought from a rival of the opponent. Other opponents may be regarded more as nuisances or, more neutrally, as policy problems than as full-fledged competitors or rivals. [...] Threatening enemies who are also adjudged to be competitors in some sense, as opposed to irritants or simply problems, are branded as rivals. This categorization is very much a social-psychological process. Actors interpret the intentions of others based on earlier behavior and forecasts about the future behavior of these other actors. The interpretation of these intentions leads to expectations about the likelihood of conflicts escalating to physical attacks. Strategic rivals anticipate some positive probability of an attack from their competitors over issues in contention.” (Thompson, 2001)

a (permanent) income-tax system in a particular year. Information on the date of introduction of an income tax is available for 76 countries and comes from Besley and Persson (2011). We use data for GDP per capita, converted to US dollars, from Penn World Tables 7.0 and CNTS, as well as measures of government expenditures per capita from the WDI and CNTS databases.

3.3.2 Specifications

Our baseline regression equation is expressed as:

$$\begin{aligned} enrollment_{i,t} = & \alpha_0 + \alpha_1 war\ risk_{i,t} + \alpha_2 democracy_{i,t} + \\ & \alpha_3 war\ risk_{i,t} \cdot democracy_{i,t} + \alpha_4 X_{i,t} + \nu_i + \delta_t + u_{i,t} , \end{aligned} \quad (3.1)$$

where $enrollment_{i,t}$ refers to the primary enrollment rate in country i and year t . Our main coefficient of interest is α_1 , which captures the effect of the war risk faced by country i in year t . As explained above, this military threat is measured either by having had a war some time in the past 10 years (i.e., between years $t - 10$ and $t - 1$) or by having at least one strategic rival in year t as defined above. We also include $democracy_{i,t}$, the democracy index in country i at time t , and an interaction term between war risk and democracy, as well as a set of control variables $X_{i,t}$. Finally, and importantly, the specification entails country fixed effects ν_i , and year fixed effects δ_t . Hence, the effects we estimate are identified from the variation over time within countries of the right-hand side variables relative to their world average levels..

We also estimate the probability of a discrete education reform according to the

following Probit specification:

$$\begin{aligned} \Pr(reform_{i,t}) = & \beta_0 + \beta_1 war\ risk_{i,t} + \beta_2 democracy_{i,t} + \\ & \beta_3 war\ risk_{i,t} \cdot democracy_{i,t} + \beta_4 X_{i,t} + \eta_i + \mu_t + v_{i,t} , \end{aligned} \quad (3.2)$$

where the *reform* variable is either *imputed reforms* (for the entire sample of countries) or *known reforms* (for the historical European sample).

Our main prediction is that the coefficients which capture the effect of war risk on education policy should be positive. We exclude countries at war from the sample, as an ongoing war (as opposed to a latent rivalry) may severely increase the opportunity cost of public funds. Maybe more importantly, data in times of war tend to be unreliable. The expected coefficient on democracy is not clear a priori. On the one hand, the median voter in a democracy may be poorer than in an autocracy and thus more favorable to mass education. On the other hand, a rent-seeking policymaker in an autocracy may be more likely to appropriate the future benefits of higher income due to education investments, and therefore more inclined to incur the cost of educational reforms than a democratic government.

3.3.3 Descriptive statistics

Descriptive statistics for the annual data underlying the specifications with continuous primary enrollment (as in (3.1)) as the left-hand side variables are shown in Table 3.2. These data are averaged over 5-year periods for the specifications with imputed reforms (as in (3.2)) as the left-hand side variable. As the table shows, 16% of the country-years in our sample have a war in the previous 10 years, around 50% are associated with one or more strategic rivalries, and 4% involve war with another state.

Table 3.2: **Summary statistics (yearly)**

Variable	Obs	Mean	Std. Dev.	Min	Max
Enrollment per 10,000	6939	1052.99	528.29	1	3023
Rivalry	6939	0.496	0.500	0	1
Rel. army largest rival	6359	1.106	2.777	0	56
Rel. army total rivals	6359	1.653	4.303	0	59
War in previous 10 years	6939	0.159	0.366	0	1
Lost war casualties	6939	0.033	0.281	0	7.932
Won war casualties	6939	0.028	0.214	0	3.922
Polity2	6939	-0.369	7.116	-10	10
Democracy indicator	6939	0.424	0.494	0	1
Population growth (10 yrs)	5401	19.31	14.89	-53.65	178.52
Military expenditure p.c.	6194	48.11	218.98	0	7398.57
Govt expenditure p.c.	6362	161.97	538.71	0.31	8402.08
Income tax	4207	0.681	0.466	0	1
GDP p.c.	4150	1563.04	3543.89	18	38344.9

Of the country-years in the sample, about 42% have positive values of the democracy score, with a mean score of -0.37 . We see a large variance in the severity of war threats either in terms of the number of casualties in past wars, or in terms of the relative size of the military in the largest rival (or the sum of rivals) vs. the country itself.

3.4 Empirical results

3.4.1 Primary enrollment rates

Baseline results

Table 3.3 shows the results from our baseline estimation of (3.1) on the yearly panel, with primary enrollment rates as the dependent variable and war risk measured by the presence of an ongoing military rivalry. All specifications include 10-

year population growth, to account for varying shares of school-age children in total population, as well as military expenditure per capita, to control for the possibility that military spending may crowd out education spending. Indeed, we find that high population growth rates are consistently associated with higher primary enrollment per capita, while military spending – holding constant the level of external threats – has a negative coefficient. A natural interpretation of the latter is that fiscal capacity is limited, so that more effort towards building an army restricts the ability of the government to invest in mass education.

Column 1 shows that the correlation between rivalry and primary enrollment is positive and significant. In column 2, we add the democracy score. Interestingly, when faced with the same level of military threats, autocracies invest more in education than democracies. This finding runs counter to the median voter view of mass education reforms, which would predict better education outcomes in more democratic countries. Also, the coefficient on military rivalry remains stable as we control for the political regime, which appears inconsistent with the view that democratization *per se* would be the main underlying force behind increases in primary enrollment across countries. In column 3, we add an interaction term to check if the impact of rivalries on educational investments differs by political regime. We find that primary enrollment responds more positively to military threats in democracies than in autocracies. We discuss the democracy results in Subsection 3.4.3 below.

Covariates

In columns 4 and 5, we include the relative strength of rivals, defined as the military size of the largest rival (column 4) or of the sum of rivals (column 5), in both cases divided by the size of the country's own military. The point estimates

Table 3.3: Primary enrollment and military rivalry (OLS)

	Rate of primary enrollment					
	(1)	(2)	(3)	(4)	(5)	(6)
Rivalry	55.843*** [17.537]	54.922*** [17.820]	94.242*** [17.891]	78.431*** [19.905]	77.437*** [19.798]	63.460*** [20.274]
Polity2		-6.877*** [1.152]	-17.644*** [1.474]	-18.952*** [1.484]	-18.979*** [1.482]	-17.986*** [1.499]
Rivalry*Polity2			22.261*** [1.943]	23.331*** [2.064]	23.390*** [2.065]	22.420*** [2.076]
Rel. army largest rival				2.521 [2.672]		
Rel. army total rivals					2.157 [1.518]	4.108*** [1.544]
Govt expenditure p.c.						-0.250*** [0.014]
Population growth	9.033*** [0.473]	9.423*** [0.489]	8.811*** [0.485]	9.807*** [0.545]	9.808*** [0.545]	8.962*** [0.544]
Military expenditure	-0.885*** [0.049]	-0.898*** [0.050]	-0.885*** [0.049]	-1.150*** [0.061]	-1.148*** [0.061]	-0.337*** [0.080]
Observations	4849	4636	4636	4285	4285	3995
R-squared	0.675	0.670	0.679	0.697	0.698	0.722

All specifications include country and time fixed effects.

Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

suggest that countries with stronger rivals (i.e., with a higher risk of losing a potential war) have higher enrollment rates, magnifying the effect of war threats for countries more likely to lose war if a war were to occur. However, this magnification effect is not statistically significant. Finally, in column 6, we control for total government expenditures per capita. Our main results are unchanged, namely the presence of a strategic rival is associated with higher enrollment in primary education, democracies have less primary education, while the interaction between the democracy indicator and military rivalry is positive. In addition, the relative strength of rivals is now significantly associated with higher enrollment rates.

Past wars instead of rivalries

Table 3.4 presents the same set of regressions, except that we replace military rivalry by the occurrence of a war in the past 10 years, distinguishing also between won and lost wars. Our main finding is that primary enrollment responds positively and significantly to a recent experience of war. Systematically, this effect appears stronger if the war was won than if it was lost. This finding goes against the view that past wars might favor future education investments because defeats weaken incumbent elites that might oppose mass education. A higher number of casualties, gauging the intensity of the recent war, tends to magnify the impact of recent wars on education, but the coefficient is only significant for wars won. Consistent with our previous set of results, we find that everything else equal, autocracies invest more in education than democracies. However, the interaction between democracy and past wars now appears to be negative (in the case of lost wars).

Table 3.4: Primary enrollment and recent wars (OLS)

	Rate of primary enrollment					
	(1)	(2)	(3)	(4)	(5)	(6)
War in	92.726***	101.734***	105.710***			
previous 10 years	[15.173]	[15.627]	[15.915]			
Won war in				123.198***	105.674***	89.445***
previous 10 years				[20.713]	[21.603]	[20.997]
Lost war in				71.446***	60.262***	26.721
previous 10 years				[20.142]	[21.232]	[21.548]
Polity2		-7.262***	-6.915***	-6.897***	-7.254***	-6.119***
		[1.148]	[1.177]	[1.178]	[1.149]	[1.147]
War in 10 years			-2.716			
*Polity2			[2.065]			
Won war*Polity2					2.051	
					[2.343]	
Lost war*Polity2					-7.495***	
					[2.181]	
Won war casualties					65.060**	73.110***
					[27.147]	[27.568]
Lost war casualties					2.141	-6.476
					[26.933]	[28.124]
Govt exp. p.c.						-0.275***
						[0.013]
Population growth.	9.191***	9.575***	9.545***	9.475***	9.597***	8.828***
	[0.472]	[0.487]	[0.487]	[0.490]	[0.487]	[0.487]
Military expenditure	-0.900***	-0.916***	-0.921***	-0.911***	-0.900***	-0.107
	[0.049]	[0.050]	[0.050]	[0.050]	[0.050]	[0.067]
Observations	4849	4636	4636	4636	4636	4307
R-squared	0.677	0.672	0.672	0.673	0.673	0.702

All specifications include country and time fixed effects.

Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

3.4.2 *Education reforms*

Next, we consider the effect of war risk on the probability of an educational reform, based on the probit regression in (3.2). Table 3.5 looks at the effects of military risk or rivalry on imputed reforms (i.e., a 10% or higher increase in primary enrollment over a five-year period). Consistent with our predictions, we find that a strategic rivalry raises the probability of a large increase in primary enrollment. However, we find no significant impact of the military strength of rivals. The democracy index still enters negatively, and its interaction with rivalry is positive although not significant, consistent with the previous tables. Finally, neither population growth, nor total government expenditure, nor military expenditure, show significant coefficients when democracy is included in the regression.

In Table 3.6, we study the effect of military threats on known reforms which broaden access to primary or secondary education. We restrict our attention to the subsample of 14 European countries for which these data are available since 1830. The results are weaker than in the previous regressions, which is not surprising with such a small number of countries. In particular, we find no effect of democracy and its interaction with rivalry. But our main findings still hold: a significant positive effect of rivalry, or rival's military strength, on the probability of observing a reform in primary or secondary education, once we control for democracy.

3.4.3 *The political regime*

Our estimates are striking in that they imply that democratic countries invest less in primary education and pursue less education reforms than autocratic countries, absent rivalries or war threats. However, the gap between democracies and autocra-

Table 3.5: Imputed education reforms and military rivalry (Probit)

	Probit for “imputed reforms”					
	(1)	(2)	(3)	(4)	(5)	(6)
Rivalry	0.271** [0.119]	0.177 [0.113]	0.190* [0.113]	0.347** [0.145]	0.379*** [0.145]	0.374** [0.148]
Polity2		-0.055*** [0.007]	-0.059*** [0.010]	-0.062*** [0.010]	-0.061*** [0.010]	-0.065*** [0.011]
Rivalry*Polity2			0.009 [0.014]	0.013 [0.017]	0.013 [0.017]	0.019 [0.017]
Rel. army largest rival				0.007 [0.029]		
Rel. army total rivals					-0.005 [0.019]	-0.000 [0.019]
Govt expenditure p.c.						0.000 [0.000]
Population growth.	0.009*** [0.003]	0.004 [0.003]	0.004 [0.003]	0.003 [0.003]	0.003 [0.003]	0.002 [0.003]
Military expenditure	-0.001** [0.000]	-0.001** [0.000]	-0.001** [0.000]	-0.001 [0.000]	-0.001 [0.000]	-0.001 [0.000]
Observations	1390	1299	1299	1163	1163	1099

All specifications include time fixed effects and standard errors clustered by country.

Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

Table 3.6: Known education reforms and military rivalry (Probit)

	Probit for "known reforms"					
	(1)	(2)	(3)	(4)	(5)	(6)
Rivalry	0.233*** [0.085]	0.235** [0.092]	0.283* [0.144]	-0.036 [0.234]	-0.111 [0.237]	-0.021 [0.213]
Polity2		0.005 [0.013]	0.000 [0.013]	-0.002 [0.023]	-0.000 [0.023]	-0.000 [0.022]
Rivalry*Polity2				0.033 [0.034]	0.040 [0.034]	0.028 [0.026]
Rel. army largest rival				0.107*** [0.024]		
Rel. army total rivals					0.074*** [0.016]	0.095*** [0.018]
Govt expenditure p.c.			0.000 [0.001]			0.000 [0.001]
Population growth	-0.001 [0.009]	-0.000 [0.009]	-0.009 [0.016]	0.006 [0.008]	0.009 [0.008]	0.009 [0.013]
Military expenditure	0.000	0.000	0.000	0.001	0.001	0.001
Observations	881	880	826	852	852	798

Standard errors clustered by country.

Robust standard errors in brackets. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

cies narrows when war risk is high.

The nature of the political system may affect education policy along several channels. As mentioned already in the introduction, extending the franchise might foster policies in the interest of the poor, which may include publicly funded primary schooling. But we find little evidence supporting this hypothesis¹⁵. A prospective mechanism leading in the opposite direction is that democratically elected leaders have higher turnover – and therefore supposedly shorter time horizons – than autocrats, which may make the former less willing to invest in mass-education policies with mainly long-term benefits. A third channel could conceivably run through the effect of rivalries and wars on regime change: wars might affect education spending mainly because they promote regime change, which in turn affects education policy. However, our findings do not support this idea, since the direct estimates of military rivalry on education remains unchanged when we hold constant the political regime. Instead, our results suggest that war threats or past wars tilt the preferences of the elite towards mass education, even in autocratic regimes where more schooling might imply a higher risk of the leader being ousted.

While the positive interaction effect is an intriguing finding which remains to be understood, our results thus suggest that military competition between states has played a more important role for the emergence of mass education than has democratization. (Section 3.5 below gives an attempt of a theoretical rationalization.)

¹⁵ As mentioned earlier, Bursztyn (2011) questions the impact of democratization on education spending based on the Brazilian example.

Disaggregating democracy

But maybe the concept of democracy is too broadbrush to help us understand the mechanisms at work. To make further progress, we try to disentangle the effects of two main components of the democracy score: constraints on the executive and the openness of executive recruitment. In Table 3.7, we thus run our main specifications, letting each of these two aspects of democracy enter separately on the right hand side. Specifically, we use *constraints on the executive* (*xconst*) in the Polity IV database, which takes values between 1 and 7, and *openness of executive recruitment* (*xropen*) in the same database, which takes values between 1 and 4.

Panel A looks at the effect on primary enrollment with military rivalry as the measure of war risk. The estimates in Columns 1 and 3 show that executive openness is negatively correlated with the enrollment rate, while executive constraints are not. However, when we introduce interaction terms between rivalry and one particular aspect of democracy in Columns 2 and 4, both direct effects are negative and significant. The interactions with rivalry are both positive and statistically significant. In Columns 5 and 6, we perform a horse race between the two measures of democracy, with or without our interaction terms. The estimates show that the direct influence of each component of democracy remains, albeit with a larger interaction term for executive openness.

Panel B considers the same specifications as Panel A, but with the probability of an imputed reform replacing primary enrollment as the dependent variable. In columns 1 and 3, constraints on the executive as well as openness of recruitment are negatively and significantly correlated with education reforms. When looking at interactions between rivalry and these two measures of democracy in columns 2 and

Table 3.7: **Components of democracy**

(a) Primary enrollment

	Primary enrollment rate					
	(1)	(2)	(3)	(4)	(5)	(6)
Rivalry	57.964*** [17.539]	-19.809 [19.387]	49.743*** [17.583]	-9.417 [31.223]	51.501*** [17.569]	54.668* [31.438]
Exec. constraints	43.401*** [15.227]	-85.481*** [20.739]			53.526*** [15.378]	-70.731*** [21.064]
Exec. const.*Rivalry		235.073*** [25.944]				223.556*** [26.169]
Exec. openness			-67.249*** [17.597]	-106.153*** [24.441]	-76.699*** [17.784]	-86.308*** [24.598]
Exec. open.*Rivalry				73.775** [32.182]		41.445 [32.108]
Population growth	8.959*** [0.474]	8.393*** [0.474]	9.070*** [0.473]	9.051*** [0.473]	8.983*** [0.473]	8.431*** [0.473]
Military expenditure	-0.876*** [0.049]	-0.873*** [0.049]	-0.883*** [0.049]	-0.879*** [0.049]	-0.871*** [0.049]	-0.867*** [0.049]
Observations	4849	4849	4849	4849	4849	4849
R-squared	0.676	0.681	0.676	0.676	0.677	0.682

All specifications include country and year fixed effects.

Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

Table 3.7: **Components of democracy** (continued)

(b) Imputed reforms

	Probability of "imputed reforms"					
	(1)	(2)	(3)	(4)	(5)	(6)
Rivalry	0.170 [0.111]	0.023 [0.140]	0.264** [0.114]	0.431 [0.338]	0.173 [0.109]	0.319 [0.322]
Exec. constraints	-0.710*** [0.119]	-0.883*** [0.144]			-0.658*** [0.119]	-0.859*** [0.147]
Exec. openness			-0.528*** [0.189]	-0.419 [0.278]	-0.324* [0.186]	-0.121 [0.270]
Exec. const.*Rivalry		0.401* [0.225]				0.458** [0.219]
Exec.open*Rivalry				-0.198 [0.342]		-0.372 [0.326]
Population growth	0.005 [0.003]	0.004 [0.003]	0.008*** [0.003]	0.008*** [0.003]	0.004 [0.003]	0.004 [0.003]
Military expenditure	-0.001** [0.000]	-0.001** [0.000]	-0.001*** [0.000]	-0.001*** [0.000]	-0.001*** [0.000]	-0.001*** [0.000]
Observations	1390	1390	1390	1390	1390	1390

All specifications include time fixed effects and standard errors clustered by country.

Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

4, however, none of the interactions comes out significant.

Overall, both measures of democracy appear to have a negative and significant direct effect, regardless of how we measure mass education. Results for the interaction effects are somewhat less clear. Taken together, the disaggregated results do not shed all that much light on the underlying mechanism whereby political regimes influence mass education.

3.4.4 Instrumental variables estimation

We have established a positive relationship between military rivalry and primary education outcomes, as well as a positive interaction between rivalry and democracy. Still, there might be concerns regarding the direction of causality. More educated countries may be more prone to have rivalries for other reasons than the hypothesized effect of primary education on their military efficiency. To disentangle the direction of causality, we use an instrumental-variables approach with two different instruments, both of which rely on the regional context in which rivalries are embedded.

Commodity-price approach

Our first IV approach relies on commodity price data. Positive shocks to the price of natural resources or agricultural commodities are likely to foster rivalries, as states will compete for the control of more valuable resources. We do not use shocks affecting a country's own commodity prices, which may affect education through other channels than the emergence of rivalries, such as their effect on the fiscal balance. Instead, our instrument is constructed exclusively from shocks to neighboring countries, which are the most likely potential rivals. The total commodity price shock variable, available for 155 countries over the period 1960-2000, comes from Aghion,

Angeletos, Banerjee, and Manova (2010). It is a composite measure calculated from yearly changes in the prices of 42 commodity categories, weighted by their average shares in the country's total exports in 1985-1987. For each country i , we define our instrument $shock_contig_{i,t}$ as the fraction of its bordering countries that experienced a positive commodity price shock of more than one standard deviation in year t . We include $shock_contig$ and up to three lags of this variable as instruments in the first stage. In the second stage, we control for the country's own commodity price shock (again, set equal to 1 if the shock is above one standard deviation in a given year). This is to rule out that the exclusion restriction is violated because of correlated commodity prices, due to similar crop choices (soil qualities) and mineral availability among neighboring countries.

The main results of the IV estimation are shown in Table 3.8. The first stage is a Probit regression for the likelihood of observing a strategic rivalry. We see from these regressions that current or recent positive commodity price shocks in neighboring countries do raise the probability of engaging in a strategic rivalry. We have tested for more lags, results not reported, and found only non-significant coefficients after year 3. In the second stage, we confirm a positive effect of rivalry on primary education and a negative effect of the democracy score. In columns 1 and 2, we run the regression without fixed effects. We find that rivalry has a positive and significant effect on primary enrollment rates. Surprisingly, the coefficient on the *democracy (polity2)* score turns out positive. However, when we include country and year fixed effects in columns 3 and 4, the same regressions yield a negative coefficient on democracy, indicating that the positive correlation was due to time-invariant country characteristics. The coefficients on military rivalry remain positive, significant and larger than their OLS counterparts. These IV results lend support to our claim that causality runs

Table 3.8: IV estimation: Commodity price shocks

	Primary enrollment rate			
	(1)	(2)	(3)	(4)
Rivalry	799.292* [434.690]	671.247*** [207.962]	292.107 [209.645]	290.874** [132.882]
Polity2	6.879*** [1.426]	6.453*** [1.557]	-8.434*** [1.258]	-6.692*** [1.340]
Military expenditure p.c.	-0.023 [0.035]	-0.064* [0.038]	-0.134*** [0.025]	-0.124*** [0.028]
Own country shock	2.846 [41.559]	-9.588 [38.961]	53.349*** [18.769]	
Year fixed effects	no	no	yes	yes
Country fixed effects	no	no	yes	yes
First stage: rivalry shock_contig	0.364*** [0.114]	0.261** [0.125]	0.364*** [0.114]	0.261** [0.125]
L.shock_contig		0.291** [0.126]		0.291** [0.126]
L2.shock_contig		0.392*** [0.129]		0.392*** [0.129]
L3.shock_contig		0.297** [0.144]		0.297** [0.144]
Observations	2402	2087	2402	2087

Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

from military threats to education policies rather than from education levels to the aggressiveness of foreign policy.

Rivalries approach

Our second IV approach relies more directly on the strategic rivalries data. It captures the exogenous component, from the perspective of a given country, of the competition between its neighbors. Specifically, this instrument *rivalry_contig* is constructed, for each country i , from rivalries of a neighboring state j with other countries k . For country i , *rivalry_contig_{i,t}* is defined as the number of rivalries between bordering states j and other countries $k \neq i$, weighted by the inverse of the distance between the countries i and j , in year t . In this calculation, we restrict attention to neighbors j which are not too small or too large relative to country i to be credible rivals, using the criterion that neighbors must have at least 30% of the population of country i and vice versa. Hence, *rivalry_contig* measures how prone the immediate regional environment of country i is to military rivalries. We also use the interaction of *rivalry_contig* and the *democracy* (*polity2*) score to instrument for the interaction term between military threats and *democracy*.

Table 3.9, panel A shows the estimates of the first-stage regressions. We find that *rivalry_contig* has predictive power for the probability that a country is engaged in a strategic rivalry, and its interaction with the democracy score is positively and significantly associated with the interaction of rivalry and *democracy*. The F-tests confirm that our instruments are not weak. Panel B of the table displays the second-stage estimates. In columns 1 and 2, the first stage is a probit regression for the probability of rivalry. In columns 3 to 5, the first stage is an OLS regression of rivalry and its interaction with *democracy* on our instruments and controls. The IV regressions

Table 3.9: IV estimation: Regional rivalries

(a) First stage

	Rivalry Probit (1)	Rivalry Probit (2)	Rivalry OLS (3)	Rivalry OLS (4)	Rivalry*polity2 OLS (5)
Rivalry_contig	15.815*** [2.654]	16.024*** [2.700]	13.514*** [1.737]	13.493*** [1.733]	-30.028* [15.927]
Polity2		0.007** [0.003]	-0.001 [0.001]	0.001 [0.001]	0.487*** [0.012]
Rivalry_contig*polity2				-0.564*** [0.163]	17.403*** [1.496]
Observations	3455	3379	3379	3379	3379
R-squared			0.772	0.773	0.825
F statistic			1450.28	1401.31	900.28

Other coefficients not reported. Standard errors in brackets.

(b) Second stage

	Primary enrollment rate				
	(1)	(2)	(3)	(4)	(5)
Rivalry	331.629 [266.452]	277.712 [271.384]	242.998 [147.834]	325.646* [167.145]	492.938*** [187.981]
Polity2		-0.508 [1.189]	-0.448 [1.376]	-20.727** [8.985]	-20.454** [8.247]
Rivalry*Polity2				36.408** [15.819]	37.543*** [14.482]
Gov't expenditure p.c.					-0.399*** [0.049]
Population growth	7.570*** [0.441]	7.809*** [0.452]	7.688*** [0.725]	6.829*** [0.833]	5.607*** [0.769]
Military expenditure p.c.	-0.579*** [0.048]	-0.574*** [0.048]	-0.585*** [0.106]	-0.605*** [0.109]	0.230* [0.138]
Endogenous variables	rivalry	rivalry	rivalry	rivalry, riv.*polity2	rivalry, riv.*polity2
First stage	Probit	Probit	OLS	OLS	OLS
Observations	3455	3379	3379	3379	3164

All specifications includes year and country FE. Western Europe excluded.

Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1.

show again a positive and significant effect of rivalry on primary enrollment rates, as well as a negative direct coefficient on democracy and a positive and significant interaction term.

These regressions exclude Western European countries, because our instrument does not capture adequately the historical determinants of rivalry in Western Europe. Most European countries in our sample were involved in treaties or alliances throughout the period considered. This makes it hard to believe that country i would not directly interact with third parties k that a neighboring country j face as rivals – such direct interaction between i and k would violate the exclusion restriction. It may also be that states involved in other rivalries did not raise the external threat perception of bordering countries, if they were bound together by alliances. Indeed, the simple correlation between the instrument and rivalry is positive and significant in all other regions, but negative in Western Europe suggesting that rivalries in this area are of a different nature¹⁶.

3.4.5 *Robustness checks*

In this section, we run a series of robustness checks to test the validity of our baseline results.

Industrialization and urbanization

First, democracy may be correlated with the level of industrialization and urbanization. If an educated military is more valuable in more industrialized countries, where the army requires more skills, we may be concerned that our interaction term

¹⁶ As it turns out, including Western European countries into this regression leads to coefficients on rivalry that are implausibly large, about ten times higher than those in Table 3.9, Panel B.

Table 3.10: Industrialization and urbanization

	Primary enrollment rate					
	(1)	(2)	(3)	(4)	(5)	(6)
Rivalry	60.902*** [17.728]	-148.555*** [32.812]	150.333*** [15.924]	-154.856*** [24.782]	118.140*** [16.255]	-254.160*** [26.133]
Polity2	-8.452*** [1.472]	-9.117*** [1.462]	-19.069*** [1.359]	-10.909*** [1.423]	-20.662*** [1.377]	-11.825*** [1.423]
Rivalry*polity2	5.621*** [1.779]	5.973*** [1.765]	21.357*** [1.734]	11.197*** [1.810]	23.297*** [1.750]	12.327*** [1.803]
Industry/GDP	7.092*** [0.758]	2.886*** [0.935]				
Riv.*industry/GDP		7.128*** [0.943]				
% Urban (50,000)			8.687*** [0.832]	-0.976 [1.016]		
Riv.*% urban (50,000)				14.523*** [0.918]		
% Urban (20,000)					5.699*** [0.700]	-1.792** [0.797]
Riv.*% urban (20,000)						12.788*** [0.716]
Observations	3551	3551	5341	5341	5134	5134
R-squared	0.785	0.789	0.712	0.725	0.715	0.732

All specifications include year and country fixed effects.

Standard errors in brackets. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

between rivalry and democracy is picking up this effect. In Table 3.10, we add as control variables several measures of industrial development and their interaction with rivalry: the share of industrial activities in GDP (available for 1946-2000), the share of population living in cities of 50,000 or more inhabitants, and the share of population living in cities of 20,000 or more inhabitants (drawn from Banks, 2011).

Most importantly, our results on democracy are unchanged: its direct coefficient is negative, its interaction with rivalry is positive, and both are significant. Moreover, as expected, more industrialized and more urbanized countries have higher rates of primary enrollment. Interestingly, we do find that enrollment responds more to military threats in countries with a larger share of industrial activities and a larger share of urban population. For a country which has a score of 0 on the *polity2* scale, the point estimates suggest that the effect of military rivalry on primary education becomes positive around a 20% share of industry in value added, or around a 10% share of population living in cities of at least 50,000 people. In short, rivalry is positively associated with primary enrollment except for the least urbanized and least industrialized countries.

Other covariates and sample selection

We perform several other robustness tests on our baseline specification in Table 3.11. In column 1, we include the index of ethnic fractionalization from Alesina, Devleeschauwer, Easterly, Kurlat, and Wacziarg (2003), as well as its interaction with rivalry. Ethnic diversity has been shown to affect the amount of social spending and in particular education investment. We find that more fractionalized countries have higher enrollment rates, but the effect of rivalry on primary enrollment decreases with ethnic fractionalization. Yet, our main coefficients remain unaffected. In column

Table 3.11: Covariates and sample selection

	Primary enrollment rate					
	(1)	(2)	(3)	(4)	(5)	(6)
Rivalry	235.331*** [50.843]	162.249 [146.363]	102.291*** [14.971]	185.977*** [22.597]	7.798 [22.872]	120.891*** [16.390]
Polity2	-6.038*** [1.836]	-89.206*** [27.911]	-5.397*** [1.187]	-8.944*** [1.753]	-8.505*** [1.272]	-2.500** [1.245]
Rivalry*polity2	2.733 [2.318]	92.965*** [27.914]	5.597*** [1.595]	14.514*** [2.323]	6.204*** [1.763]	7.671*** [1.737]
Rel. army rivals		8.685*** [1.313]	-0.707 [1.144]	10.823*** [1.446]	2.664** [1.246]	1.101 [1.261]
Ethnic frac.	1,497.845*** [332.801]					
Ethnic frac*rivalry	-313.186*** [88.696]					
Rivals enrollment		0.185*** [0.020]				
L10.Prim. enrollment			0.803*** [0.015]			
Population growth	3.689*** [0.566]	8.957*** [0.655]	3.612*** [0.454]	7.650*** [0.513]	2.880*** [0.474]	5.720*** [0.445]
Military expenditure	-0.330*** [0.042]	-0.532*** [0.067]	-0.193*** [0.051]	-0.634*** [0.065]	-0.372*** [0.048]	-0.217*** [0.053]
Observations	2692	1952	3927	3099	4285	4175
R-squared	0.778	0.838	0.838	0.813	0.842	0.816

All specifications include country and time fixed effects.

Standard errors in brackets. ***p<0.01, **p<0.05, *p<0.1.

(4) excludes Western Europe.

In (5) country FE are interacted with before/after 1950 dummies.

(6) includes continent-specific time trends.

2, we include the primary enrollment rate of the rival. Consistent with our intuition, the results show that countries increase their enrollment rates more when their rivals have more educated populations, and therefore presumably more effective armies. In column 3, we add 10-year lagged enrollment to control for initial conditions. As expected, primary enrollment displays high serial autocorrelation, but our main coefficients of interest are unchanged. In column 4, we check that our results do not reflect an entirely European story by excluding Western Europe from the sample. Again, our results are robust to this change, and the coefficients on rivalry actually increase. In column 5, we account for the possibility that country-specific factors may vary over the sample period, by interacting country fixed effects with dummies for before and after 1950. Finally in column 6, we add continent-specific time trends to the regression. Each time we find that primary enrollment rates are higher, all things equal, in countries engaged in a military rivalry, and that the effect of a rivalry is stronger in more democratic countries.

Alternative measure of education

We also compare our baseline results with those obtained with an alternative measure of primary schooling, namely education attainment from the Barro and Lee (2010) data set, available at five-year intervals for the postwar period only. We run the specifications of (3.1), using as the dependent variable the amount of primary education achieved by adults in the 15-19 age span at year $t + 5$, starting in 1950. Table 3.12 presents the results. Since education attainment is defined per person of the relevant age group, we do not need to control for population growth in these specifications. We find similar results to those in Table 3.3 – a (weakly) positive effect of rivalry, a negative effect of democracy, and a positive interaction term. The results

Table 3.12: Barro-Lee education attainment

Percentage of primary schooling attained 5 years later by adults 15-19 years old					
	(1)	(2)	(3)	(4)	(5)
Rivalry	3.049*	3.334	3.243		
	[1.844]	[2.595]	[2.571]		
Polity2	-0.365**	-0.345**	-0.346**	-0.196	-0.198
	[0.146]	[0.153]	[0.153]	[0.123]	[0.122]
Rivalry*Polity2	0.452**	0.892***	0.893***		
	[0.206]	[0.257]	[0.257]		
Rel. army largest rival		-0.151			
		[0.641]			
Rel. army total rivals			-0.095		
			[0.558]		
War in previous 10 years				7.032***	
				[2.090]	
War in 10 years*Polity2				-0.164	
				[0.257]	
Won war in previous 10 years					5.247*
					[2.882]
Lost war in previous 10 years					9.188***
					[2.619]
Won war in 10 years*Polity2					0.241
					[0.349]
Lost war in 10 years*Polity2					-0.338
					[0.315]
Military expenditure p.c.	0.006	-0.001	-0.001	0.005	0.005
	[0.004]	[0.005]	[0.005]	[0.004]	[0.004]
Govt expenditure p.c.	-0.002**	-0.001*	-0.001*	-0.001**	-0.001**
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Observations	1114	952	952	1114	1114
R-squared	0.112	0.098	0.098	0.116	0.122

All specifications include year and country FE. Robust standard errors in brackets..

Table 3.13: **Military expenditure and rivalry**

	Military expenditure per capita				
	(1)	(2)	(3)	(4)	(5)
Rivalry	34.084*** [10.049]	30.979*** [10.678]	31.256*** [10.792]	32.491*** [5.925]	32.841* [17.328]
Polity2		-4.206*** [0.706]	-4.291*** [0.852]	-2.984*** [0.394]	-9.043*** [1.307]
Rivalry*Polity2			0.204 [1.149]	-1.337** [0.624]	5.498*** [1.819]
Rel. army largest rival				0.402 [0.823]	
Share of industry in GDP					-5.406*** [0.685]
Population growth.	-1.218*** [0.241]	-1.279*** [0.257]	-1.281*** [0.257]	1.358*** [0.129]	-2.293*** [0.455]
Observations	9113	8283	8283	6914	5273
R-squared	0.451	0.442	0.442	0.684	0.403

All specifications include country and time fixed effects.

Robust standard errors in brackets. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

are somewhat weaker with the recent occurrence of an external war as the threat variable, but the positive effect of a recent war is significant.

Military expenditures

As a check that education investments are indeed driven by military concerns, we also run our baseline regression replacing education with military expenditure per capita as the left-hand side variable. As we can see in Table 3.13, we find the same pattern for military spending as we did for primary education enrollment: military spending responds positively to strategic rivalries and it is higher in autocracies.

Table 3.14: Education and probability of future victory

	Probability of war in next 10 years		Probability of winning if war in next 10 years	
	(1)	(2)	(3)	(4)
Primary enrollment per 10,000	0.001*** [0.000]	0.001*** [0.000]	0.004*** [0.001]	0.009*** [0.002]
Democracy score	0.004 [0.007]	0.007 [0.007]	0.001 [0.051]	-0.016 [0.070]
Military expenditure		0.001*** [0.000]		0.003 [0.003]
Rivalry		1.499*** [0.125]		-12.780 [290.386]
Observations	4117	3453	320	280

All specifications include year and country fixed effects.

Robust standard errors in brackets. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Education as a means to win future wars

The motive for investing in mass education in our narrative above, as well as our theory below, is that a more educated population is more effective at fighting wars. If we regress the probability of winning the next war, conditional on a war outbreak in the next 10 years, we do find that it is positively and significantly associated with current primary enrollment. The regressions are shown in Table 3.14. Together with the historical evidence outlined in Section 3.2, these findings support the view that military threats spur investments in mass education in order to build more effective armies. We also find that primary education has some predictive power on the probability of observing a war in the near future.

Other robustness tests¹⁷

We have performed other robustness tests as well. One is to consider yet another measure of external threats, based on future conflicts. If countries correctly anticipate war risks, the incidence of future wars should proxy for military threats *ex ante*. This proxy is more vulnerable to endogeneity concerns than our rivalry or past war data, as the willingness to engage in wars can be influenced by past education levels. Despite this word of caution, it provides a useful check to our main hypothesis. We run (3.1) measuring war risk by a binary variable that takes a value of one if and only if a war breaks out in the following 10 years. Our results are the same in the basic specification, namely: future wars enter positively in the enrollment regression, democracy enters negatively, and the interaction term is positive.

We have also checked the sensitivity of our results to the threshold of education expansion used to define imputed reforms. Specifically, we have used thresholds of 5% and 15% expansions in the last five years, instead of 10%. The signs of the coefficients on rivalry and on the democracy score are similar to those obtained with our baseline specification, although the interaction term between rivalries and democracy is no longer significant.

Summary of empirical findings

Taken together, our empirical results provide robust evidence that in the wake of increased strategic rivalry (or in reaction to past wars), countries invest more in mass education. Everything else equal, democracies invest less in primary education than do autocracies. But the interaction between democracy indicators and military rivalry

¹⁷ To save space, we do not show the corresponding regression results. These are available upon request.

appears to be positive, especially when democracy is measured by constraints on the executive.

3.5 *A simple theory*

How can we understand the empirical results summarized at the end of the previous section? This is certainly not obvious, but in this section we propose a simple theoretical model that may help rationalize our main findings. In line with the historical discussion and the focus of our empirical work, the model highlights the prospective role of public education in the efficient operation of the military.

Basic setup

The formal model we develop borrows in spirit from the state-capacity framework of Besley and Persson (2009, 2011), from the voter participation frameworks by Feddersen and Sandroni (2006) and Coate and Conlin (2004), and from the analysis by Ticchi and Vindigni (2009) of fighting incentives across different political regimes. Consider a society, where the population is normalized to unity and divided into two equally large and homogenous groups (with regard to education) of risk-neutral individuals, $J = I, O$. There are two time periods. Output per capita in each period – equal to total resources and the tax base – is exogenous and constant over time and normalized to $\frac{1}{2}$. All consumption takes place at the end of the second period.

One of the groups serves as the incumbent in both periods (thus there is no political turnover). Among political institutions, we focus on the constraints on the executive. These are modeled as a share of output δ that the incumbent group, I , must grant to the opposition group, O . Hence a higher value of δ captures more democratic institutions in the sense of higher checks and balances, protecting oppo-

sition groups from discretionary redistribution. A war can occur in period 2 with exogenous probability p . For simplicity, all accumulated income perishes from the country as a whole – i.e., to both groups – if a war is lost.

The conditional probability q of winning a war, once it has broken out, depends on individual effort choices by the members of each group in period 2. Specifically, each individual can expend a unit of effort at an individual specific utility cost that is decreasing in the level of education e . We assume a very simple cost function $\frac{x}{e}$, where variable x is individual-specific and uniformly distributed on $[0, 1]$ in each group. Any individual in group J will follow a behavioral rule to expend his unit of effort if $\frac{x}{e} < \frac{\omega_J}{e}$, where ω_J is the rule set by group J members, which if followed by all other members of the group, maximizes the group's aggregate utility (in Feddersen and Sandroni's language, each individual member of group J wants to "do her part" to maximize the group's utility).

We assume that the conditional probability of winning the war depends on the shares of individuals in each group that expend effort:

$$q = \frac{1}{\alpha} \left[\left(\int_0^{\omega_O} dx \right)^\alpha + \left(\int_0^{\omega_I} dx \right)^\alpha \right] = \frac{1}{\alpha} (\omega_O^\alpha + \omega_I^\alpha),$$

where we assume that $\alpha < 1$. This formulation assumes that efforts of the two groups are complementary. This could be for geographical reasons: if the two groups inhabit different parts of the country's territory, effort is needed along different parts of the border. Another possibility is that the groups represent an dominant elite from which officers are drawn and a large non-elite from which common soldiers are drawn: again, effort is needed from both groups.

Thus, education in this basic model only serves to cut the cost of each individual's perceived fighting effort, but it is straightforward to let output depend on the level

of education (see further below). The level of education is chosen by the incumbent group. Specifically, in period 1, the incumbent group can augment the initial education level, normalized at zero, by investment e in future education at cost $C(e) = e^\gamma$, where $\gamma > 1$. We study this choice of education below.

Timing

The timing of the model is as follows:

1. In period 1, the incumbent makes investment e in future education
2. At the beginning of period 2, a war with a foreign power erupts with probability p .
3. If war has erupted, members of each group choose the behavioral rule for effort choice, thus setting ω_I and ω_O . Individual members of each group observe the individual component of their effort cost x and then choose whether to expend one unit of effort at cost $\frac{x}{e}$.
4. If a war has erupted, it is won with probability q .
5. If no war has erupted or a war has been won, the incumbent group consumes $1 - \delta$, while the opposition group consumes δ .

To analyze the model, we proceed by backward induction, starting from the effort choices at stage 3 and going back to the education choice at stage 1. For simplicity, we assume no time discounting.

Equilibrium

Without a behavioral rule for effort choice, individuals would face a severe free-rider problem similar to the problem of voter participation. In our setting, individuals choose to expend effort when their utility cost is low enough. In analogy with the analyses in Feddersen and Sandroni (2006) and Coate and Conlin (2004), we assume that group members choose the behavioral rule that maximizes the expected payoff to the group: i.e., expected consumption minus the group-wide cost of effort.

Thus, group O solves

$$\max_{\omega_I} \left\{ q\delta - \left(\int_0^{\omega_O} \frac{x}{e} dx \right) \right\} = \left\{ \frac{1}{\alpha} (\omega_O^\alpha + \omega_I^\alpha) \delta - \frac{1}{e} \frac{\omega_O^2}{2} \right\} ,$$

taking ω_I as given, while the incumbent group's effort solves

$$\max_{\omega_I} \left\{ \frac{1}{\alpha} (\omega_O^\alpha + \omega_I^\alpha) (1 - \delta) - \frac{1}{e} \frac{\omega_I^2}{2} \right\} .$$

Simple algebra gives us:

$$\omega_O = (\delta e)^{\frac{1}{2-\alpha}} \quad \text{and} \quad \omega_I = ((1 - \delta)e)^{\frac{1}{2-\alpha}} .$$

In equilibrium, the conditional probability of winning a war q becomes¹⁸:

$$q^*(e, \delta) = \frac{1}{\alpha} e^{\frac{\alpha}{2-\alpha}} \left[\delta^{\frac{\alpha}{2-\alpha}} + (1 - \delta)^{\frac{\alpha}{2-\alpha}} \right] .$$

¹⁸ Note that we are implicitly assuming an interior solution $q^* \in (0, 1)$. This in turn is guaranteed by assuming γ sufficiently large, which in turn implies that the equilibrium e is sufficiently small.

Moving back to period 1, the incumbent group chooses education investment e to

$$\max_e \{[(1-p) + pq^*(e, \delta)](1-\delta) - C(e)\}.$$

The first-order condition becomes:

$$C'(e) = p(1-\delta) \frac{\partial q^*(e, \delta)}{\partial e}, \quad (3.3)$$

or

$$\gamma e^{\gamma-1} = \frac{p(1-\delta)}{2-\alpha} \left[\delta^{\frac{\alpha}{2-\alpha}} + (1-\delta)^{\frac{\alpha}{2-\alpha}} \right] e^{\frac{2(\alpha-1)}{2-\alpha}},$$

which implies equilibrium educational investment

$$e = \left\{ \frac{p(1-\delta)}{\gamma(2-\alpha)} \left[\delta^{\frac{\alpha}{2-\alpha}} + (1-\delta)^{\frac{\alpha}{2-\alpha}} \right] \right\}^{\frac{2-\alpha}{(\gamma-1)(2-\alpha)+2(1-\alpha)}}. \quad (3.4)$$

Equation (3.4) immediately implies that for γ sufficiently large the expression $q^*(e, \delta) = \frac{1}{\alpha} e^{\frac{\alpha}{2-\alpha}} \left[\delta^{\frac{\alpha}{2-\alpha}} + (1-\delta)^{\frac{\alpha}{2-\alpha}} \right]$ strictly lies between 0 and 1, as claimed earlier.

Comparative statics

One can now show:

Proposition 3.1 *For δ small enough and γ large enough that we do not run into corners, equilibrium investment in education e , is increasing in the risk of war, p , and positively affected by the interaction between democracy δ and the risk of war p , namely: $\frac{\partial e}{\partial p} > 0$ and $\frac{\partial^2 e}{\partial p \partial \delta} > 0$.*

Proof 3.1 *The first part follows straightforwardly from (3.4); the second part follows from the*

fact that:

$$\text{sign} \left(\frac{\partial^2 e}{\partial p \partial \delta} \right) = \text{sign} \left(\frac{\partial}{\partial \delta} \{ (1 - \delta) E(\delta) \} \right) ,$$

where

$$E(\delta) \equiv \left[\delta^{\frac{\alpha}{2-\alpha}} + (1 - \delta)^{\frac{\alpha}{2-\alpha}} \right] .$$

But one can verify that

$$\frac{\partial}{\partial \delta} \{ (1 - \delta) E(\delta) \} = -E(\delta) + (1 - \delta) \left(\frac{\alpha}{2 - \alpha} \right) \left(\delta^{\frac{\alpha}{2-\alpha}-1} - (1 - \delta)^{\frac{\alpha}{2-\alpha}-1} \right) ,$$

where the first term in the RHS of the above equation remains bounded when $\delta \rightarrow 0$ whereas the second term becomes arbitrarily large. This establishes the Proposition.

Intuitively, these results of our model capture a relatively simple idea. Society's income is (partly) expropriated if a war is lost to a foreign power. The probability of winning a war depends upon both the educational level and fighting efforts by members of the incumbent and opposition groups. In these circumstances, the incumbent group has stronger motives to invest in education if a war becomes more likely. Absent democracy in the form of some checks and balances, however, opposition-group members do not benefit a great deal from the economy's resources. Therefore, they have weaker incentives to exert fighting effort than members of the incumbent group – this mechanism is similar to the one in Ticchi and Vindigni (2009). If the efforts by the incumbent and opponent groups are sufficiently complementary ($\alpha < 1$), this incentive gap may lower the prospects of winning a war to such an extent that investments in education respond less to a higher war threat in autocracies than in democracies.

As it stands, the above model does not predict different signs for the direct effect of democracy on education $\frac{\partial e}{\partial \delta}$ and the interaction effect $\frac{\partial^2 e}{\partial p \partial \delta}$. However, once we allow output y to also depend positively on education, then the direct effect of democracy can become negative. For example, suppose that $y = y(e) = 1 + \beta e$, with β small. For small enough β , it is still the case (by continuity) that for sufficiently low $\delta : \frac{\partial e}{\partial p} > 0$ and $\frac{\partial^2 e}{\partial p \partial \delta} > 0$. But in addition, we also obtain $\frac{\partial e}{\partial \delta} < 0$. To see the latter, note that in the extended model, the first-order condition for e becomes

$$C'(e) = (1-p)(1-\delta)y'(e) + p(1-\delta)\frac{\partial[q^*(e, \delta)y(e)]}{\partial e},$$

where $y'(e) = \beta > 0$.

In the absence of military rivalry, i.e., for $p = 0$, we can write equilibrium educational investment as

$$e = \left[\frac{(1-\delta)\beta}{\gamma} \right]^{\frac{1}{\gamma-1}}.$$

Clearly, education is now decreasing in democracy parameter δ . By continuity, the results remains true for p sufficiently small.

Intuitively, democracy has a direct negative effect on the motives to invest in education, simply because stronger checks and balances reduce the incumbent's residual claim on the additional output generated by education.

An auxiliary prediction

The unverifiable and complementary decisions on fighting effort by the two groups are the drivers of the model's positive interaction effect between military threats and democracy. But for other types of physical investments, their contribution to military success presumably depend less on such efforts. Following this logic, military

Table 3.15: Road investments, rivalry and democracy

	% change in length of paved roads			
	(1)	(2)	(3)	(4)
Rivalry	1.856** [0.859]	1.801** [0.853]	1.732** [0.862]	1.879** [0.861]
Polity2		0.035 [0.053]	0.059 [0.068]	0.034 [0.071]
Rivalry*Polity2			-0.051 [0.089]	-0.048 [0.090]
Real GDP				4.149* [2.465]
Military expenditure p.c.	0.003 [0.002]	0.004** [0.002]	0.004** [0.002]	0.005* [0.003]
Observations	9113	8283	8283	6914
R-squared	0.451	0.442	0.442	0.684

All specifications include country and time FE and SE clustered by country. Standard errors in brackets. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

rivalry might affect other measures of state capacity such as infrastructure, but the interaction between rivalry and democracy should be less significant. We confront this auxiliary prediction of the model with data on the length of paved roads from Calderón and Servén (2010), which covers 97 countries over the period 1960-2000. Table 3.15 shows the results of estimating our main specification with the yearly percentage change in the length of paved roads as the left-hand side variable. While military rivalries still drive this type of investment, we find no effect – either directly nor through the interaction term – of the political regime on road-building.

3.6 *Conclusion*

We have argued that military rivalry is an important factor behind countries' decisions to invest in mass primary education. Democratization does not seem to play an important role, even though primary enrollment appears to respond more to threats in democracies than in autocracies. Moreover, a more severe war, as measured by a higher number of casualties, tends to magnify the impact of recent wars on education, whereas the impact of military rivalry on primary education is larger in more industrialized countries and in those facing stronger and more educated rivals.

Our approach could be extended in several directions. A first would be to investigate if economic rivalry – e.g., measured by trade competition – has a similar effect on education policies as military rivalry. A second direction would be to endogenize fiscal capacity and in particular look at how much current or past military rivalry affects future fiscal capacity. Yet another would be to consider not only the size of primary enrollment, but also the governance of primary and secondary schools. Recent work by Algan, Cahuc, and Shleifer (2011) distinguishes between vertical and horizontal school pedagogy, where the former relies heavily upon taking notes from the teacher, whereas the latter involves group interactions among students. Our conjecture is that primary-education reforms primarily driven by past military rivalry should put vertical systems in place, which may prevail still today. This and other extensions are left for future research.

APPENDIX

A. APPENDIX TO CHAPTER 1

A.1 Proofs

A.1.1 Proof of Lemma 1.1

Assume $\mu > \frac{k}{1-w}$. First, we have

$$\frac{\mu - k}{w} > \mu > \theta^*$$

which ensures

$$\pi_{t+1}(\theta) = \mu - w\theta - k > 0$$

for all firms born at t which have quality $\theta < \theta^*$. Hence all such firms enter initially.

Also, $\theta < \frac{k}{1-w}$ and $\rho' > 0$ imply

$$E_t \pi_{t+s}(\theta) = (\rho(s-1) - w)\theta + (1 - \rho(s-1))\mu - k$$

is decreasing in s and

$$\lim_{s \rightarrow \infty} E_t \pi_{t+s} = (1 - w)\theta - k < 0$$

so all firms below θ^* expect to exit in finite time when their profits turn negative. The expected number of periods a firm θ born at t is active is $T(\theta)$ given by

$$\begin{aligned}
[1 - \rho(T(\theta - 1))] \mu &> [w - \rho(T(\theta) - 1)] \theta + k \\
\text{and} \quad [1 - \rho(T(\theta))] \mu &< [w - \rho(T(\theta))] \theta + k
\end{aligned}$$

The highest quality type θ_T that exits after selling for T periods (or the lowest quality type that exits after selling for $T + 1$ periods) is defined by $E_t \pi_{t+T+1}(\theta_T) = 0$, hence

$$\theta_T = \max \left\{ \frac{k - [1 - \rho(T)] \mu}{\rho(T) - w}, \theta_m \right\}$$

and θ_T is increasing with T :

$$\frac{\partial \theta_T}{\partial T} \propto \rho'(T) (\mu(1 - w) - k) > 0 \text{ as } \rho' > 0 \text{ and } \mu > \theta^*$$

Second, firms with $\theta^* < \theta < \mu$ expects positive profits at all periods: they have $E_t \pi_{t+s}(\theta)$ monotonically decreasing from

$$\pi_{t+1}(\theta) = \mu - w\theta - k > \mu(1 - w) - k > 0 \text{ since } \theta < \mu$$

to

$$\lim_{s \rightarrow \infty} E_t \pi_{t+s}(\theta) = \theta(1 - w) - k > 0 \text{ since } \theta > \theta^*$$

Hence firms with $\theta^* < \theta < \mu$ always enter the market and stay until they are exogenously forced to exit.

Finally, firms with $\theta > \mu$ have increasing expected profits over time. They enter the market if and only if their expected intertemporal profits are positive, which requires:

$$E_t \left(\sum_{s=1}^{\infty} \delta^{s-1} \pi_{t+s}(\theta) \right) = \sum_{s=0}^{\infty} \delta^s [(\rho(s) - w)\theta + (1 - \rho(s))\mu] - \frac{k}{1-\delta} > 0$$

or equivalently:

$$\theta > \frac{k - \mu(1-\delta) \sum_{s=0}^{\infty} \delta^s (1 - \rho(s))}{(1-\delta) \sum_{s=0}^{\infty} \delta^s \rho(s) - w} \equiv \theta_H$$

Let us show that $\theta_H < \mu$:

$$\theta_H < \mu \Leftrightarrow \mu \left[(1-\delta) \sum_{s=0}^{\infty} \delta^s (1 - \rho(s)) + (1-\delta) \sum_{s=0}^{\infty} \delta^s \rho(s) \right] > w\mu + k \Leftrightarrow \mu > \frac{k}{1-w}$$

which holds by assumption in the high reputation case. Hence all firms with $\theta > \mu$ always export until they are hit by the exogenous shock.

A.1.2 Proof of Lemma 1.2

Assume $\mu < \frac{k}{1-w}$ and $\mu > k + w\theta_m$. First, consider firms with $\theta < \mu$ born at date t . Since their expected profits are decreasing with time, they are active in the first period if and only if $E_t \pi_{t+1}(\theta) = \mu - w\theta - k > 0$, which requires

$$\theta \leq \frac{\mu - k}{w} \equiv \theta_L$$

and we can immediately check that

$$\mu < \frac{k}{1-w} \Leftrightarrow \theta_L < \mu.$$

Expected second-period profits are

$$E_t \pi_{t+2}(\theta) = (\rho(1) - w)\theta + (1 - \rho(1))\mu - k < (1 - w)\mu - k < 0$$

since $\theta < \mu$ and $\rho(1) > w$. Hence among firms with $\theta < \mu$, those with $\theta < \theta_L$ are active in the first period and exit afterwards, and those with $\theta_L \leq \theta < \mu$ are never active.

Second, consider firms with $\mu \leq \theta < \theta^*$. These firms have $E_t \pi_{t+1}(\theta) < 0$ since $\theta > \theta_L$, $E_t \pi_{t+s}(\theta)$ monotonically increasing in s since $\theta \geq \mu$, and $\lim_{s \rightarrow \infty} E_t \pi_{t+s}(\theta) < 0$ since $\theta < \theta^*$. Thus their expected profits are negative in all periods and they optimally exit after drawing their quality parameter.

Third, consider firms with $\theta > \theta^*$. These firms have $E_t \pi_{t+s}(\theta)$ monotonically increasing in s since $\theta > \mu$, and $\lim_{s \rightarrow \infty} E_t \pi_{t+s}(\theta) > 0$ since $\theta > \theta^*$. If they decide to be active in the first period, they expect to remain in the market as long as they survive the exogenous shock. However given $\theta > \theta_L$ they incur a loss in the initial periods. The condition for a firm of type $\theta > \theta^*$ to be active is for intertemporal expected profits to be positive, which requires

$$\theta > \frac{k - (1 - A_\rho)\mu}{A_\rho - w} \equiv \theta_H$$

as derived in the proof of Lemma 1.1, where we define $A_\rho \equiv (1 - \delta) \sum_{s=0}^{\infty} \delta^s \rho(s)$.

Finally,

$$\theta_H > \theta^* \Leftrightarrow \frac{k - (1 - A_\rho)\mu}{A_\rho - w} > \frac{k}{1 - w} \Leftrightarrow k(1 - A_\rho) > (1 - A_\rho)\mu(1 - w)$$

which is equivalent to

$$\frac{k}{1 - w} > \mu$$

and holds by assumption in the low reputation case. Hence firms with $\theta^* \leq \theta \leq \theta_H$ are never active and firms with $\theta > \theta_H$ enter the export market and stay active.

A.1.3 Proof of Proposition 1.1

A HQE is a fixed point of $\bar{\theta}(\cdot)$ where

$$\bar{\theta}(\mu) = \mu_0 \left(\frac{1 - \sum_{T=0}^{\infty} \delta^{T+1} \left(\left(\frac{\theta_m}{\theta_T} \right)^{\alpha-1} - \left(\frac{\theta_m}{\theta_{T+1}} \right)^{\alpha-1} \right)}{1 - \sum_{T=0}^{\infty} \delta^{T+1} \left(\left(\frac{\theta_m}{\theta_T} \right)^{\alpha} - \left(\frac{\theta_m}{\theta_{T+1}} \right)^{\alpha} \right)} \right)$$

$$\bar{\theta}(\mu) = \mu_0 \left(\frac{1 + \sum_{T=\tilde{T}}^{\infty} \delta^T \left(\frac{\theta_m}{\theta_T} \right)^{\alpha-1}}{1 + \sum_{T=\tilde{T}}^{\infty} \delta^T \left(\frac{\theta_m}{\theta_T} \right)^{\alpha}} \right)$$

and \tilde{T} is the lowest value of T such that $\theta_T > \theta_m$.

Step 1: Let us show that $\bar{\theta}(\mu)$ is strictly decreasing in μ on $[\theta^*, \infty)$. We have

$$\bar{\theta} = \mu_0 \left(\frac{1 + K(\alpha - 1)}{1 + K(\alpha)} \right) \quad \text{where } K(\alpha) \equiv \sum_{T=\tilde{T}}^{\infty} \delta^T \left(\frac{\theta_m}{\theta_T} \right)^{\alpha}$$

$$\frac{\partial K(\alpha)}{\partial \alpha} = \sum_{T=\tilde{T}}^{\infty} \delta^T \ln(\theta_m / \theta_T) \left(\frac{\theta_m}{\theta_T} \right)^{\alpha} < 0$$

Consider a change in one of the thresholds, θ_S , leaving unchanged all other thresholds. Then all else equal, average quality rises:

$$\begin{aligned} \frac{\partial \bar{\theta}}{\partial \theta_S} &= \frac{\delta^S}{\theta_S} \left(\frac{\theta_m}{\theta_S} \right)^{\alpha-1} \left[\alpha \left(\frac{\theta_m}{\theta_S} \right) (1 + K(\alpha - 1)) - (\alpha - 1) (1 + K(\alpha)) \right] \\ &= \frac{\delta^S}{\theta_S} \left(\frac{\theta_m}{\theta_S} \right)^{\alpha-1} (1 + K(\alpha)) \left[\alpha \left(\frac{\theta_m}{\theta_S} \right) \frac{\bar{\theta}}{\mu_0} - (\alpha - 1) \right] \\ &= \frac{\delta^S}{\theta_S} \left(\frac{\theta_m}{\theta_S} \right)^{\alpha-1} (1 + K(\alpha)) (\alpha - 1) \left[\left(\frac{\bar{\theta}}{\theta_S} \right) - 1 \right] > 0 \end{aligned}$$

which derives from $\bar{\theta} > \theta^* > \theta_S$ for all S in a HQE. An increase in μ lowers all θ_T given Assumption 1 and differentiating:

$$\frac{\partial \theta_T}{\partial \mu} = -\frac{1 - \rho(T)}{\rho(T) - w}$$

Thus, in a HQE, $\bar{\theta}(\mu)$ is a decreasing function:

$$\frac{\partial \bar{\theta}}{\partial \mu} = \sum_{T=\bar{T}}^{\infty} \frac{\partial \bar{\theta}}{\partial \theta_T} \frac{\partial \theta_T}{\partial \mu} < 0$$

We have proved that $\bar{\theta}$ is strictly and continuously decreasing in μ on $[\theta^*, \infty)$.

Step 2: Show that

$$\lim_{\mu \rightarrow \infty} \frac{\bar{\theta}(\mu)}{\mu} < 1$$

As $\mu \rightarrow \infty$, it remains profitable for all firms to stay active, so firms of all qualities continue exporting until hit by the exogenous shock: $T(\theta) \rightarrow \infty$ for all θ . Therefore, $\lim_{\mu \rightarrow \infty} \mu_0 = \mu_0$ which is finite, so $\lim_{\mu \rightarrow \infty} \frac{\bar{\theta}(\mu)}{\mu} < 1$.

By the fixed point theorem, we have established that if $\bar{\theta}(\theta^*) > \theta^*$, $\bar{\theta}(\cdot)$ has a unique fixed point on (θ^*, ∞) , which proves Proposition 1.1.

Step 3: Derive the condition for $\bar{\theta}(\theta^*) > \theta^*$. At $\mu = \theta^*$, $\pi_t(\theta) < 0$ for all $t > 1$ and $\theta < \theta^*$. Then

$$\bar{\theta}(\theta^*) = \frac{\int_{\theta_m}^{\theta^*} \theta dG(\theta) + \frac{1}{1-\delta} \int_{\theta^*}^{\infty} \theta dG(\theta)}{\int_{\theta_m}^{\theta^*} dG(\theta) + \frac{1}{1-\delta} \int_{\theta^*}^{\infty} dG(\theta)} = \mu_0 \left(\frac{1 - \delta + \delta \left(\frac{\theta_m}{\theta^*} \right)^{\alpha-1}}{1 - \delta + \delta \left(\frac{\theta_m}{\theta^*} \right)^{\alpha}} \right)$$

So we have

$$\begin{aligned}
\bar{\theta}(\theta^*) &> \theta^* \Leftrightarrow \mu_0 \left(\frac{1 - \delta + \delta \left(\frac{\theta_m(1-w)}{k} \right)^{\alpha-1}}{1 - \delta + \delta \left(\frac{\theta_m(1-w)}{k} \right)^\alpha} \right) > \frac{k}{1-w} \\
&\Leftrightarrow \alpha \left(\frac{\theta_m(1-w)}{k} \right) + \frac{\delta}{1-\delta} \left(\frac{\theta_m(1-w)}{k} \right)^\alpha > \alpha - 1
\end{aligned}$$

A.1.4 Proof of Proposition 1.2

A LQE is a fixed point of $\bar{\theta}(\mu)$ where:

$$\bar{\theta}(\mu) = \mu_0 \left(\frac{(1-\delta) \left(1 - \left(\frac{\theta_m}{\theta_L} \right)^{\alpha-1} \right) + \left(\frac{\theta_m}{\theta_H} \right)^{\alpha-1}}{(1-\delta) \left(1 - \left(\frac{\theta_m}{\theta_L} \right)^\alpha \right) + \left(\frac{\theta_m}{\theta_H} \right)^\alpha} \right)$$

Step 1: The sign of $\frac{\partial \bar{\theta}(\mu)}{\partial \mu}$ is indeterminate. Differentiate with respect to each threshold:

$$\begin{aligned}
\frac{\partial \bar{\theta}}{\partial \theta_L} &= \frac{\mu_o(\alpha-1)}{1 - \left(\frac{\theta_m}{\theta_L} \right)^\alpha + \frac{1}{1-\delta} \left(\frac{\theta_m}{\theta_H} \right)^\alpha} \left(\frac{1}{\theta_L} \right) \left(\frac{\theta_m}{\theta_L} \right)^{\alpha-1} \left[1 - \frac{\bar{\theta}}{\theta_L} \right] < 0 \\
\frac{\partial \bar{\theta}}{\partial \theta_H} &= \frac{\frac{1}{1-\delta} \mu_o(\alpha-1)}{1 - \left(\frac{\theta_m}{\theta_L} \right)^\alpha + \frac{1}{1-\delta} \left(\frac{\theta_m}{\theta_H} \right)^\alpha} \left(\frac{1}{\theta_H} \right) \left(\frac{\theta_m}{\theta_H} \right)^{\alpha-1} \left[\frac{\bar{\theta}}{\theta_H} - 1 \right] < 0
\end{aligned}$$

$$\begin{aligned}
\frac{\partial \bar{\theta}}{\partial \mu} &= \frac{\partial \bar{\theta}}{\partial \theta_L} \frac{\partial \theta_L}{\partial \mu} + \frac{\partial \bar{\theta}}{\partial \theta_H} \frac{\partial \theta_H}{\partial \mu} \\
&= \frac{\mu_o(\alpha-1)}{1 - \left(\frac{\theta_m}{\theta_L} \right)^\alpha + \frac{1}{1-\delta} \left(\frac{\theta_m}{\theta_H} \right)^\alpha} \left[\left(\frac{\theta_m^{\alpha-1}}{\theta_L^\alpha} \right) \left[\frac{\bar{\theta}}{\theta_L} - 1 \right] \left(\frac{1}{w} \right) - \frac{1}{1-\delta} \left(\frac{\theta_m^{\alpha-1}}{\theta_H^\alpha} \right) \left[1 - \frac{\bar{\theta}}{\theta_H} \right] \left(\frac{1-A_\rho}{A_\rho-w} \right) \right] \\
\frac{\partial \bar{\theta}}{\partial \mu} &< 0 \text{ iff } \frac{1}{1-\delta} \left(\frac{1}{\theta_H} \right)^\alpha \left[1 - \frac{\bar{\theta}}{\theta_H} \right] \left(\frac{1-A_\rho}{A_\rho-w} \right) > \left(\frac{1}{\theta_L} \right)^\alpha \left[\frac{\bar{\theta}}{\theta_L} - 1 \right] \left(\frac{1}{w} \right)
\end{aligned}$$

This condition can be rewritten as

$$\delta > 1 - \left(\frac{\theta_L}{\theta_H} \right)^{\alpha+1} \left(\frac{\theta_H - \bar{\theta}}{\bar{\theta} - \theta_L} \right) \left(\frac{(1 - A_\rho) w}{A_\rho - w} \right)$$

Then note that the bracketed terms are:

$$\begin{aligned} \frac{\theta_L}{\theta_H} &= \frac{(\mu - k)(A_\rho - w)}{w(k - (1 - A_\rho)\mu)} \\ \frac{\theta_H - \bar{\theta}}{\bar{\theta} - \theta_L} &= \frac{\frac{k - (1 - A_\rho)\mu}{A_\rho - w} - \bar{\theta}}{\bar{\theta} - \frac{\mu - k}{w}} = \frac{w}{A_\rho - w} \left(1 - \frac{A_\rho(\bar{\theta} - \mu)}{k - \mu + w\bar{\theta}} \right) \end{aligned}$$

Therefore $\bar{\theta}(\mu)$ decreases in μ when

$$\delta > 1 - \left(\frac{\mu - k}{k - (1 - A_\rho)\mu} \right)^{\alpha+1} \left(\frac{A_\rho - w}{w} \right)^{\alpha-1} \left(1 - \frac{A_\rho(\bar{\theta} - \mu)}{k - \mu + w\bar{\theta}} \right)$$

and decreases in μ otherwise. The reason why $\bar{\theta}(\mu)$ needs not be monotonic over $[\theta_m, \theta^*]$ is that μ has opposite effects on $\bar{\theta}$ coming from θ_L and θ_H . Which effect dominates depends on the position of μ as well as the shape parameter α and the survival parameter δ . This non-monotonicity is what gives rises to the possibility of multiple equilibria.

Step 2: If $\mu = \theta_m$, no firm below θ^* finds it profitable to export, as national reputation imposes a first-period loss on all firms. Some firms with high enough θ have a positive NPV of future profits and enter. So since θ_m is the lower bound of the prior quality distribution, $\bar{\theta}(\theta_m) > \theta^* > \theta_m$.

Step 3: From the derivation of Proposition 1.1 we know that

$$\bar{\theta}(\theta^*) < \theta^* \Leftrightarrow \alpha \left(\frac{\theta_m(1-w)}{k} \right) + \frac{\delta}{1-\delta} \left(\frac{\theta_m(1-w)}{k} \right)^\alpha < \alpha - 1$$

So we have proved that if this condition holds, there is no HQE and there must be at least one LQE.

A.1.5 Proof of Result 1.1

In a LQE, the set of continuing firms is $[\theta_H, \infty)$ from the second period onwards, so the average price $\bar{p}_{t,t+s}^{lqe}$ of cohort t at time $t+s$ is given by:

$$\bar{p}_{t,t+s}^{lqe}(\bar{\theta}) = \begin{cases} \bar{\theta} & \text{if } s = 1 \\ \bar{\theta} + \rho(s) \left(\frac{\alpha}{\alpha-1} \theta_H - \bar{\theta} \right) & \text{if } s > 1 \end{cases}$$

As $\bar{\theta} < \theta_H$ in a LQE and $\rho(s)$ increases in s , it immediately follows that $\bar{p}_{t,t+s}^{lqe}$ increases with s .

In a HQE, the set of active firms of cohort t at time $t+s$ is $[\theta_{s-1}, \infty)$, and their average price is:

$$\bar{p}_{t,t+s}^{hqe}(\bar{\theta}) = \begin{cases} \bar{\theta} & \text{if } s = 1 \\ \bar{\theta} + \rho(s) \left(\frac{\alpha}{\alpha-1} \theta_{s-1} - \bar{\theta} \right) & \text{if } s > 1 \end{cases}$$

$\rho(s)$ and θ_{s-1} increase with s . Immediately following the entry of cohort t , $\bar{p}_{t,t+s}^{hqe}$ may fall with s if the distribution of θ has low variance (α high), such that $\frac{\alpha}{\alpha-1} \theta_1 > \mu$. In this case, there is initially a large mass of firms at the bottom of the distribution of continuing firms and their prices are falling. However, since $\mu < \frac{\alpha}{\alpha-1} \theta^*$, there is some finite s' such that for all $s \geq s'$, $\bar{p}_{t,t+s+1}^{hqe}(\bar{\theta}) > \bar{p}_{t,t+s}^{hqe}(\bar{\theta})$ and thus at each given point

in time, the average unit price is higher for older cohorts of firms.

A.1.6 Proof of Result 1.2

The first part establishes that across cohorts, the fraction of active firms that exit per period is higher for lower quality firms. In a LQE, the hazard rate is 1 for firms below θ_L and $1 - \delta$ for firms above θ_H . In a HQE, the hazard rate is $\frac{1-\delta}{1-\delta^T}$ for firms between θ_{T-1} and θ_T for all T , which is decreasing in T , and $1 - \delta$ for firms above θ^* .

The second part states that the probability of exit, across quality levels, decreases with the age of a cohort. In a LQE, the hazard rate of cohort t at time $t + s$ is

$$h_{t,t+s}^{lqe} = \begin{cases} 1 - \delta + \delta \frac{G(\theta_L)}{G(\theta_L) + 1 - G(\theta_H)} & \text{if } s = 1 \\ 1 - \delta & \text{if } s > 1 \end{cases}$$

It falls from $t + 1$ to $t + 2$ and remains constant thereafter. In a HQE, the hazard rate of cohort t at $t + s$ is

$$\begin{aligned} h_{t,t+s}^{hqe} &= 1 - \delta + \delta \frac{G(\theta_s) - G(\theta_{s-1})}{1 - G(\theta_{s-1})} \\ &= 1 - \delta + \delta \left(1 - \left(\frac{\theta_{s-1}}{\theta_s} \right)^\alpha \right) \end{aligned}$$

Since $\frac{\theta_{s-1}}{\theta_s}$ is decreasing in s , $h_{t,t+s}^{hqe}$ falls over time.

A.1.7 Proof of Proposition 1.3

In a LQE, average quality is given by:

$$\bar{\theta} = \mu_0 \left(\frac{(1-\delta) \left(1 - \left(\frac{\theta_m}{\theta_L} \right)^{\alpha-1} \right) + \left(\frac{\theta_m}{\theta_H} \right)^{\alpha-1}}{(1-\delta) \left(1 - \left(\frac{\theta_m}{\theta_L} \right)^{\alpha} \right) + \left(\frac{\theta_m}{\theta_H} \right)^{\alpha}} \right)$$

Differentiate with respect to each threshold:

$$\begin{aligned} \frac{\partial \bar{\theta}}{\partial \theta_L} &= \frac{\mu_0 (\alpha - 1)}{1 - \left(\frac{\theta_m}{\theta_L} \right)^{\alpha} + \frac{1}{1-\delta} \left(\frac{\theta_m}{\theta_H} \right)^{\alpha}} \left(\frac{1}{\theta_L} \right) \left(\frac{\theta_m}{\theta_L} \right)^{\alpha-1} \left(1 - \frac{\bar{\theta}}{\theta_L} \right) < 0 \\ \frac{\partial \bar{\theta}}{\partial \theta_H} &= \frac{\frac{1}{1-\delta} \mu_0 (\alpha - 1)}{1 - \left(\frac{\theta_m}{\theta_L} \right)^{\alpha} + \frac{1}{1-\delta} \left(\frac{\theta_m}{\theta_H} \right)^{\alpha}} \left(\frac{1}{\theta_H} \right) \left(\frac{\theta_m}{\theta_H} \right)^{\alpha-1} \left(\frac{\bar{\theta}}{\theta_H} - 1 \right) < 0 \end{aligned}$$

$$\begin{aligned} \frac{\partial \bar{\theta}}{\partial k} &= \frac{\partial \bar{\theta}}{\partial \theta_L} \frac{\partial \theta_L}{\partial k} + \frac{\partial \bar{\theta}}{\partial \theta_H} \frac{\partial \theta_H}{\partial k} \\ &= \frac{\mu_0 (\alpha - 1)}{1 - \left(\frac{\theta_m}{\theta_L} \right)^{\alpha} + \frac{1}{1-\delta} \left(\frac{\theta_m}{\theta_H} \right)^{\alpha}} \times \dots \\ &\quad \left[\frac{1}{1-\delta} \left(\frac{1}{\theta_H} \right) \left(\frac{\theta_m}{\theta_H} \right)^{\alpha-1} \left(1 - \frac{\bar{\theta}}{\theta_H} \right) \left(\frac{1}{A_\rho - w} \right) - \left(\frac{1}{\theta_L} \right) \left(\frac{\theta_m}{\theta_L} \right)^{\alpha-1} \left(\frac{\bar{\theta}}{\theta_L} - 1 \right) \left(\frac{1}{w} \right) \right] \\ \frac{\partial \bar{\theta}}{\partial k} &> 0 \text{ iff } \frac{1}{1-\delta} \left(\frac{1}{\theta_H} \right)^{\alpha} \left(1 - \frac{\bar{\theta}}{\theta_H} \right) \left(\frac{1}{A_\rho - w} \right) > \left(\frac{1}{\theta_L} \right)^{\alpha} \left(\frac{\bar{\theta}}{\theta_L} - 1 \right) \left(\frac{1}{w} \right) \end{aligned}$$

This condition can be rewritten as

$$\delta > 1 - \left(\frac{\theta_L}{\theta_H} \right)^{\alpha+1} \left(\frac{\theta_H - \bar{\theta}}{\bar{\theta} - \theta_L} \right) \left(\frac{w}{A_\rho - w} \right)$$

Then note that, starting from a steady-state ($\bar{\theta} = \mu$), the bracketed terms are:

$$\frac{\theta_L}{\theta_H} = \frac{(\mu - k)(A_\rho - w)}{w(k - (1 - A_\rho)\mu)}$$

$$\frac{\theta_H - \bar{\theta}}{\bar{\theta} - \theta_L} = \frac{\frac{1}{A_\rho - w}(k - (1 - w)\mu)}{\frac{1}{w}(k - (1 - w)\mu)} = \frac{w}{A_\rho - w}$$

Therefore $\bar{\theta}$ decreases in k if and only if

$$\delta > 1 - \left(\frac{\mu - k}{k - (1 - A_\rho)\mu} \right)^{\alpha+1} \left(\frac{A_\rho - w}{w} \right)^{\alpha-1}$$

The RHS is decreasing in μ and α , so this holds for δ not too low, α not too high and an initial μ not too low. Then starting from a LQE, a decrease in k moves up the $\bar{\theta}(\mu)$ function left of the initial μ . The new steady-state equilibrium quality and reputation are necessarily higher. If the steady-state is unique, the new steady-state has higher μ . If there are multiple steady-states, ranked by increasing μ , either the new steady-state has the same rank and higher μ , or the new steady-state has higher rank and higher μ .

The welfare effect of a subsidy σ ($\sigma = -dk$) has three components. First, for firms with θ parameters such that they sell both without and with the subsidy, the policy adds to their profits the amount it costs to the government, plus the extra profits brought by a higher reputation $\mu' > \mu$. The total effect is unambiguously positive.

Second, for new exporters that enter around θ_L because of the policy ($\theta_L < \theta < \theta_{L'}$), the net benefit NB_L of the subsidy is positive:

$$NB_L = \int_{\theta_L}^{\theta_{L'}} (\mu' - w\theta - k + \sigma) dG(\theta) - \int_{\theta_L}^{\theta_{L'}} \sigma g(\theta) d\theta$$

$$\begin{aligned}
NB_L &= (\mu' - k) \int_{\theta_L}^{\theta_{L'}} g(\theta) d\theta - w \int_{\theta_L}^{\theta_{L'}} \theta dG(\theta) \\
&= \left[(\mu' - k) \left(\left(\frac{\theta_m}{\theta_L} \right)^\alpha - \left(\frac{\theta_m}{\theta_{L'}} \right)^\alpha \right) - w \frac{\alpha}{\alpha-1} \theta_m \left(\left(\frac{\theta_m}{\theta_L} \right)^{\alpha-1} - \left(\frac{\theta_m}{\theta_{L'}} \right)^{\alpha-1} \right) \right] \\
&= w \theta_m \left[\left(\frac{\theta_{L'}}{\theta_L} \left(\frac{\theta_m}{\theta_L} \right)^{\alpha-1} - \left(\frac{\theta_m}{\theta_{L'}} \right)^{\alpha-1} \right) - \frac{\alpha}{\alpha-1} \left(\left(\frac{\theta_m}{\theta_L} \right)^{\alpha-1} - \left(\frac{\theta_m}{\theta_{L'}} \right)^{\alpha-1} \right) \right] \\
&> \frac{w \theta_m}{\alpha-1} \left(\left(\frac{\theta_m}{\theta_L} \right)^{\alpha-1} - \left(\frac{\theta_m}{\theta_{L'}} \right)^{\alpha-1} \right) > 0
\end{aligned}$$

where we go from the second to the third line using $w\theta_{L'} = \mu' - k$.

Third, for new exporters that enter around θ_H because of the policy ($\theta_{H'} < \theta < \theta_H$), the net benefit NB_H of the subsidy is also positive:

$$\begin{aligned}
NB_H &= \int_{\theta_{H'}}^{\theta_H} \left(\sum_{t=0}^{\infty} \delta^t (\rho(t) \theta + (1 - \rho(t)) \mu' - w\theta - k + \sigma) \right) g(\theta) d\theta - \dots \\
&\quad \frac{1}{1-\delta} \int_{\theta_{H'}}^{\theta_H} \sigma g(\theta) d\theta \\
&= \frac{1}{1-\delta} \int_{\theta_{H'}}^{\theta_H} ((A_\rho - w) \theta + (1 - A_\rho) \mu' - k) g(\theta) d\theta \\
&= \frac{1}{1-\delta} \left[- (k - (1 - A_\rho) \mu') \left(\left(\frac{\theta_m}{\theta_{H'}} \right)^\alpha - \left(\frac{\theta_m}{\theta_H} \right)^\alpha \right) + \frac{\alpha(A_\rho - w)}{\alpha-1} \theta_m \left(\left(\frac{\theta_m}{\theta_{H'}} \right)^{\alpha-1} - \left(\frac{\theta_m}{\theta_H} \right)^{\alpha-1} \right) \right] \\
&= \frac{1}{1-\delta} (A_\rho - w) \theta_m \left[\left(\left(\frac{\theta_m}{\theta_{H'}} \right)^{\alpha-1} - \frac{\theta_{H'}}{\theta_H} \left(\frac{\theta_m}{\theta_H} \right)^{\alpha-1} \right) - \frac{\alpha}{\alpha-1} \left(\left(\frac{\theta_m}{\theta_{H'}} \right)^{\alpha-1} - \left(\frac{\theta_m}{\theta_H} \right)^{\alpha-1} \right) \right] \\
&> \frac{1}{1-\delta} (A_\rho - w) \frac{\theta_m}{\alpha-1} \left(\left(\frac{\theta_m}{\theta_{H'}} \right)^{\alpha-1} - \left(\frac{\theta_m}{\theta_H} \right)^{\alpha-1} \right) > 0
\end{aligned}$$

So the overall welfare gain is positive.

A.1.8 Proof of Proposition 1.4

In a HQE, average quality is given by

$$\begin{aligned}
\bar{\theta} &= \mu_0 \left(\frac{1 + K(\alpha - 1)}{1 + K(\alpha)} \right) \quad \text{where } K(\alpha) \equiv \sum_{T=\tilde{T}}^{\infty} \delta^T \left(\frac{\theta_m}{\theta_T} \right)^\alpha, \quad \theta_T = \frac{k - (1 - \rho(T))\mu}{\rho(T) - w} \\
\frac{\partial \theta_T}{\partial k} &= \frac{1}{\rho(T) - w} > 0 \quad \text{for all } T > \tilde{T} \\
\frac{\partial \bar{\theta}}{\partial k} &= \sum_{T=\tilde{T}}^{\infty} \frac{\partial \bar{\theta}}{\partial \theta_T} \frac{\partial \theta_T}{\partial k} > 0
\end{aligned}$$

using the derivations in the proof of Proposition 1.1. Hence a subsidy that lowers k shifts down the $\bar{\theta}(\mu)$ function. As $\bar{\theta}$ is decreasing in μ in the HQE region, the new steady-state equilibrium defined by $\bar{\theta}(\mu) = \mu$ necessarily has lower μ . So average quality and national reputation are higher in the HQE steady-state without subsidies than with subsidies.

A.1.9 Proof of Proposition 1.5

This appendix section provides a sketch of the proof of Proposition 1.5. It essentially relies on the stability of μ_S and μ'_S and the instability of μ_U . For (i) and (ii), let us show that if μ_S is a steady-state LQE and $\frac{\partial \bar{\theta}(\mu)}{\partial \mu} < 0$ at μ_S , then μ_S is a stable equilibrium for $\eta < 1$. Define $\theta_{L,S} \equiv \frac{\mu_S - k}{w}$ and $\theta_{H,S} \equiv \frac{k - (1 - A_\rho)\mu_S}{A_\rho - w}$. At time $t - 1$ the economy is in an initial steady-state where

$$\mu_S = \bar{\theta}(\mu_S) = \mu_0 \left(\frac{1 - \left(\frac{\theta_m}{\theta_{L,S}} \right)^{\alpha-1} + \left(\frac{\theta_m}{\theta_{H,S}} \right)^{\alpha-1}}{1 - \left(\frac{\theta_m}{\theta_{L,S}} \right)^\alpha + \left(\frac{\theta_m}{\theta_{H,S}} \right)^\alpha} \right)$$

Suppose $\bar{\theta}$ is locally decreasing in μ . Then for all $\mu_S < \mu < \mu_U$, $\bar{\theta}(\mu) < \mu$. Now suppose there is a perturbation at time t such that $\mu_t = \mu_S + \varepsilon$, $\varepsilon > 0$ and $\varepsilon < \mu_U - \mu_S$.

The entry thresholds at t are:

$$\begin{aligned}\theta_{L,t} &= \frac{\mu_t - k}{w} = \frac{\mu_S + \varepsilon - k}{w} \\ \theta_{H,t} &= \frac{k - (1 - \delta) \sum_{u=0}^{\infty} (1 - \rho(u)) \mu_{t+u}}{A_\rho - w}\end{aligned}$$

where $\theta_{H,t}$ is determined by the zero intertemporal profits condition

$$\sum_{u=0}^{\infty} \delta^u [(\rho(u) - w) \theta_{H,t} + (1 - \rho(u)) E_t \mu_{t+u} - k]$$

and the absence of aggregate uncertainty allows us to remove the expectations operator.

Let us conjecture, to be verified, that $\mu_S \leq \mu_{t+u+1} \leq \mu_{t+u} \leq \mu_S + \varepsilon$ for all $u \geq 1$.

Then:

$$\begin{aligned}\theta_{L,S} &< \theta_{L,t+u+1} < \theta_{L,t+u} < \theta_{L,t} \\ \theta_{H,S} &> \theta_{H,t+u+1} > \theta_{H,t+u} > \theta_{H,t}\end{aligned} \quad \text{for all } u \geq 1$$

The average quality of exports is determined by the θ_L and θ_H thresholds in the periods after the shock in the following manner:

$$\begin{aligned}\bar{\theta}_{t+u} &= \mu_0 \left(\frac{1 - \left(\frac{\theta_m}{\theta_{L,t+u}}\right)^{\alpha-1} + \sum_{l=0}^u \delta^{u-l} \left(\frac{\theta_m}{\theta_{H,t+l}}\right)^{\alpha-1} + \sum_{l=u+1}^{\infty} \delta^l \left(\frac{\theta_m}{\theta_{H,S}}\right)^{\alpha-1}}{1 - \left(\frac{\theta_m}{\theta_{L,t+u}}\right)^{\alpha} + \sum_{l=0}^u \delta^{u-l} \left(\frac{\theta_m}{\theta_{H,t+l}}\right)^{\alpha} + \sum_{l=u+1}^{\infty} \delta^l \left(\frac{\theta_m}{\theta_{H,S}}\right)^{\alpha}} \right) \quad \text{for } u \geq 0 \\ \theta_{L,t+u} &= \frac{\mu_{t+u} - k}{w} \\ \theta_{H,t+u} &= \frac{k - (1 - \delta) \sum_{l=0}^{\infty} (1 - \rho(l)) \mu_{t+u+l}}{A_\rho - w}\end{aligned}$$

At time t , let us define $\bar{\theta}_t^{perm}$ as the average quality that would prevail if firms

expected the shock to be permanent, i.e. if $E_t \mu_{t+u} = \mu_t$ for all $u \geq 0$. We have:

$$\bar{\theta}_t = \mu_0 \left(\frac{1 - \left(\frac{\theta_m}{\theta_{L,t}}\right)^{\alpha-1} + \left(\frac{\theta_m}{\theta_{H,t}}\right)^{\alpha-1} + \frac{\delta}{1-\delta} \left(\frac{\theta_m}{\theta_{H,S}}\right)^{\alpha-1}}{1 - \left(\frac{\theta_m}{\theta_{L,t}}\right)^{\alpha} + \frac{\delta}{1-\delta} \left(\frac{\theta_m}{\theta_{H,t}}\right)^{\alpha} + \frac{\delta}{1-\delta} \left(\frac{\theta_m}{\theta_{H,S}}\right)^{\alpha}} \right)$$

$$\bar{\theta}_t < \bar{\theta}_t^{perm} = \mu_0 \left(\frac{1 - \left(\frac{\theta_m}{\theta_{L,t}}\right)^{\alpha-1} + \left(\frac{\theta_m}{\theta_{H,t}^{perm}}\right)^{\alpha-1} + \frac{\delta}{1-\delta} \left(\frac{\theta_m}{\theta_{H,S}}\right)^{\alpha-1}}{1 - \left(\frac{\theta_m}{\theta_{L,t}}\right)^{\alpha} + \frac{\delta}{1-\delta} \left(\frac{\theta_m}{\theta_{H,t}^{perm}}\right)^{\alpha} + \frac{\delta}{1-\delta} \left(\frac{\theta_m}{\theta_{H,S}}\right)^{\alpha}} \right)$$

as $\theta_{H,t}^{perm} = \frac{k-(1-A_p)(\mu_S+\varepsilon)}{A_p-w} < \theta_{H,t}$ from the conjecture $\mu_S \leq \mu_{t+u+1} \leq \mu_{t+u} \leq \mu_S + \varepsilon$ for all $u \geq 1$. Also

$$\bar{\theta}_t^{perm} < \bar{\theta}(\mu_S + \varepsilon) < \mu_t$$

The first inequality results from $\theta_{H,S} > \theta_{H,t}^{perm}$. The second inequality comes from $\bar{\theta}(\mu) < \mu$ for $\mu \in (\mu_S, \mu_U)$. Hence $\bar{\theta}_t < \mu_t$ and therefore:

$$\bar{\theta}_t < \mu_{t+1} = \mu_t + \eta(\bar{\theta}_t - \mu_t) < \mu_t$$

Additionally as long as η is not too close to 1, $\mu_{t+1} > \mu_S$.

We can show, similarly, that in all subsequent periods, $\bar{\theta}_{t+u} < \mu_{t+u}$ as long as $\mu_{t+u} > \mu_S$. Thus $\mu_{t+u+1} < \mu_{t+u}$ for all u and the conjecture that μ_{t+u} follows a decreasing path from $\mu_S + \varepsilon$ to μ_S is verified. In case of a negative shock to μ at time t starting from a steady-state where $\bar{\theta}$ is locally decreasing in μ , the proof is identical with opposite signs. It follows that if μ_S is a steady-state reputation and $\bar{\theta}(\mu)$ is locally decreasing in μ at μ_S , then μ_S is stable. Any positive shock, starting from μ_S , that brings μ_t to a value in (μ_S, μ_U) has no long-run effects as the economy moves back to μ_S .

By the same reasoning, μ_U is unstable. Suppose there is a negative shock to μ starting from

$$\mu_U = \bar{\theta}(\mu_U) = \mu_0 \left(\frac{1 - \left(\frac{\theta_m}{\theta_{L,U}}\right)^{\alpha-1} + \left(\frac{\theta_m}{\theta_{H,U}}\right)^{\alpha-1}}{1 - \left(\frac{\theta_m}{\theta_{L,U}}\right)^{\alpha} + \left(\frac{\theta_m}{\theta_{H,U}}\right)^{\alpha}} \right)$$

where $\theta_{L,U} \equiv \frac{\mu_U - k}{w}$, $\theta_{H,U} \equiv \frac{k - (1 - A_p)\mu_U}{A_p - w}$ and $\bar{\theta}(\mu)$ is increasing in μ at μ_U . At time t , $\mu_t = \mu_U - \varepsilon$, where $\varepsilon > 0$ and $\varepsilon < \mu_U - \mu_S$. We conjecture $\mu_S \leq \mu_{t+u+1} \leq \mu_{t+u} \leq \mu_U - \varepsilon$, which implies $\theta_{L,S} < \theta_{L,t+u+1} < \theta_{L,t+u} < \theta_{L,U}$ and $\theta_{H,S} > \theta_{H,t+u+1} > \theta_{H,t+u} > \theta_{H,U}$ for all $u \geq 0$. Then $\bar{\theta}_{t+u} < \mu_{t+u}$ and thus $\mu_{t+u+1} < \mu_{t+u}$ for all $u \geq 0$.

For part (iii), consider a “large shock”, starting from μ_S , as a shock $\varepsilon > \mu_U - \mu_S$ such that if $\mu_t = \mu_S + \varepsilon$, then $\underline{\mu} > \mu_U$, where $\bar{\theta}_t$ is defined as in (ii) and $\underline{\mu}$ is defined below. $\bar{\theta}_{t+u}$, $\theta_{L,t+u}$ and $\theta_{H,t+u}$ are defined as in part (ii). Also, for $\mu_U < \mu < \mu'_S$, we know that $\bar{\theta}(\mu) > \mu$. We can then show that $\bar{\theta}_{t+u}$ is increasing in u as long as $\bar{\theta}_{t+u} < \mu'_S$, and μ_{t+u} is increasing in u for $u \geq \underline{u}$ if $\mu_{t+u} > \mu_U$ for all $u \geq 0$. \underline{u} is the inflexion point of the path of μ_{t+u} , which can initially decrease but is eventually increasing as long as $\mu < \mu'_S$. Define $\underline{\mu} = \mu_{t+\underline{u}}$, a large reputation shock is a shock such that $\underline{\mu} > \mu_U$. It ensures that reputation and average quality both grow along the transition path until the economy reaches the steady-state μ'_S .

Finally, note that more entry and higher reputation in the long-run imply higher aggregate profits and higher average quality. The latter follows from $\bar{\theta} = \mu$ in the long run. The former results from a higher number of active firms and the fact that the range of firms which are active both with the initial μ and with the higher final μ receive a higher sequence of prices.

A.1.10 Proof of Appendix A.3 results

Case 1: Part (i) follows immediately from $\theta_L = \frac{\mu - k}{\tau w}$ and $\theta_H = \frac{k - \frac{1}{\tau}(1 - A_\rho)\mu}{\frac{1}{\tau}A_\rho - w}$. The proof of part (ii) uses the derivations of Proposition 1.2. We know

$$\begin{aligned}\bar{\theta} &= \mu_0 \left(\frac{(1 - \delta) \left(1 - \left(\frac{\theta_m}{\theta_L} \right)^{\alpha-1} \right) + \left(\frac{\theta_m}{\theta_H} \right)^{\alpha-1}}{(1 - \delta) \left(1 - \left(\frac{\theta_m}{\theta_L} \right)^\alpha \right) + \left(\frac{\theta_m}{\theta_H} \right)^\alpha} \right) \\ \frac{\partial \bar{\theta}}{\partial \tau} &= \frac{\partial \bar{\theta}}{\partial \theta_L} \frac{\partial \theta_L}{\partial \tau} + \frac{\partial \bar{\theta}}{\partial \theta_H} \frac{\partial \theta_H}{\partial \tau} \\ &= \frac{\frac{1}{\tau^2} \frac{\mu_0}{\theta_m} (\alpha-1)}{1 - \left(\frac{\theta_m}{\theta_L} \right)^\alpha + \frac{1}{1-\delta} \left(\frac{\theta_m}{\theta_H} \right)^\alpha} \left[\frac{1}{1-\delta} \left(\frac{\theta_m^\alpha}{\theta_H^\alpha} \right) \left(1 - \frac{\bar{\theta}}{\theta_H} \right) \left(\frac{(1-A_\rho)\mu + A_\rho\theta_H}{\frac{1}{\tau}A_\rho - w} \right) - \left(\frac{\theta_m^\alpha}{\theta_L^\alpha} \right) \left(\frac{\bar{\theta}}{\theta_L} - 1 \right) \left(\frac{\mu}{w} \right) \right] \\ \frac{\partial \bar{\theta}}{\partial \tau} &> 0 \text{ iff}\end{aligned}$$

$$\frac{1}{1-\delta} \left(\frac{1}{\theta_H} \right)^\alpha \left(1 - \frac{\bar{\theta}}{\theta_H} \right) \left(\frac{(1-A_\rho)\mu + A_\rho\theta_H}{\frac{1}{\tau}A_\rho - w} \right) > \left(\frac{1}{\theta_L} \right)^\alpha \left(\frac{\bar{\theta}}{\theta_L} - 1 \right) \left(\frac{\mu}{w} \right)$$

This condition can be rewritten as

$$\delta > 1 - \left(\frac{\theta_L}{\theta_H} \right)^{\alpha+1} \left(\frac{\theta_H - \bar{\theta}}{\bar{\theta} - \theta_L} \right) \left(\frac{w}{\frac{1}{\tau}A_\rho - w} \frac{(1-A_\rho)\mu + A_\rho\theta_H}{\mu} \right)$$

Then note that, starting from a steady-state ($\bar{\theta} = \mu$), the bracketed terms are:

$$\begin{aligned}\frac{\theta_L}{\theta_H} &= \frac{\left(\frac{1}{\tau}\mu - k \right) \left(\frac{1}{\tau}A_\rho - w \right)}{w \left(k - \frac{1}{\tau} \left(1 - A_\rho \right) \mu \right)} \\ \frac{\theta_H - \bar{\theta}}{\bar{\theta} - \theta_L} &= \frac{w}{\frac{1}{\tau}A_\rho - w}\end{aligned}$$

Therefore $\bar{\theta}$ decreases in τ if and only if

$$\delta > 1 - \left(\frac{\frac{1}{\tau}\mu - k}{k - \frac{1}{\tau}(1 - A_\rho)\mu} \right)^{\alpha+1} \left(\frac{\frac{1}{\tau}A_\rho - w}{w} \right)^{\alpha-1} \left(1 - A_\rho + \frac{A_\rho\theta_H}{\mu} \right)$$

Under this condition, starting from a LQE, an increase in τ moves down the $\bar{\theta}(\mu)$ function. The new steady-state equilibrium quality and reputation are lower.

Case 2: In a HQE with trade costs,

$$\begin{aligned} \theta^* &= \frac{k}{\frac{1}{\tau} - w} \\ \theta_T &= \frac{k - \frac{1}{\tau}(1 - \rho(T))\mu}{\frac{1}{\tau}\rho(T) - w} \end{aligned}$$

Part (i) follows from (A.1) and modified Assumption 1 that θ_T increases with τ .

Part (ii) is similar to the proof of Proposition 1.4. In a HQE, average quality is

$$\bar{\theta} = \mu_0 \left(\frac{1 + K_\tau(\alpha - 1)}{1 + K_\tau(\alpha)} \right) \text{ where } K_\tau(\alpha) \equiv \sum_{T=\tilde{T}}^{\infty} \delta^T \left(\frac{\theta_m}{\theta_T} \right)^\alpha, \quad \theta_T = \frac{k - \frac{1}{\tau}(1 - \rho(T))\mu}{\frac{1}{\tau}\rho(T) - w}$$

$$\begin{aligned} \frac{\partial \theta_T}{\partial \tau} &= \left(\frac{1}{\tau^2} \right) \frac{(1 - \rho(T))\mu + \rho(T)\theta_T}{\frac{1}{\tau}\rho(T) - w} > 0 \quad \text{for all } T > \tilde{T} \\ \frac{\partial \bar{\theta}}{\partial \tau} &= \sum_{T=\tilde{T}}^{\infty} \frac{\partial \bar{\theta}}{\partial \theta_T} \frac{\partial \theta_T}{\partial \tau} > 0 \end{aligned}$$

using the derivations in the proof of Proposition 1. Hence an rise in the ad valorem tariff τ shifts up the $\bar{\theta}(\mu)$ function. As $\bar{\theta}$ is decreasing in μ in the HQE region, the new steady-state equilibrium defined by $\bar{\theta}(\mu) = \mu$ necessarily has higher μ . So average quality and national reputation are higher, and the volume of trade is lower, in the new steady state.

A.2 Informed and uninformed buyers

Suppose the population of importers is divided into N equal-sized groups. There is perfect information diffusion within groups but no information diffusion across groups. Thus, if any individual in group n has previously consumed the output of firm j , then all buyers in group n are informed about good j . When firm j is matched with buyer i , $i \in I$ if there exists $i' \in n$ such that i' has been matched with j in the past, and $i \in U$ if there is no $i' \in n$ such that i' has been matched with j in the past. Further assume that the firm observes in any period whether its buyer is informed or not, but not which group the buyer belongs to; hence it does not know the exact proportion of informed buyers in any period but only its expectation.

It follows immediately from this setup that $\rho(0) = 0$. After the firm has exported for one period, one group is informed, so $\rho(1) = \frac{1}{N}$. For each subsequent period, if the fraction of informed buyers after s export periods is $\rho(s)$, then with probability $\rho(s)$, the firm is matched with a buyer in an informed group, and the proportion of informed importers stays at $\rho(s)$ for the next period. With probability $1 - \rho(s)$, the firm is matched with a buyer in an uninformed group; then the fraction of informed importers next period is $\rho(s) + \frac{1}{N}$.

Therefore, the expected fraction of informed buyers is given by the following path:

$$\begin{aligned}\rho(0) &= 0 \\ \rho(s+1) &= \rho(s)^2 + (1 - \rho(s)) \left(\rho(s) + \frac{1}{N} \right) = \rho(s) \left(\frac{N-1}{N} \right) + \frac{1}{N} \text{ for } s \geq 0\end{aligned}$$

We can check that this function satisfies Assumption 1.

$$\begin{aligned}\rho(s+1) - \rho(s) &= \frac{1}{N} (1 - \rho(s)) > 0 \\ \frac{\rho(s+1) - \rho(s)}{\rho(s)} &= \frac{1}{N} \left(\frac{1}{\rho(s)} - 1 \right) \text{ is decreasing in } s \\ \lim_{s \rightarrow \infty} \rho(s) &= \frac{1}{N} \left(1 - \frac{N-1}{N} \right)^{-1} = 1\end{aligned}$$

So $\rho(s)$ is increasing in s , rises with s at a falling rate, and converges to 1.

A.3 *Ad valorem tariffs*

A straightforward extension of the model allows for ad valorem trade costs. Suppose that when a buyer pays $p_{t+s}(j)$ defined by (1.4) for the output of firm j , the firm receives $\frac{1}{\tau} p_{t+s}(j)$, where $\tau > 1$. The price being set by the importer's maximum willingness to pay, trade costs are borne by exporters.

We modify Assumption 2 accordingly: let us assume $\frac{1}{\tau} \rho(1) > w$. With positive trade costs, the values of the relevant thresholds are modified as follows:

$$\begin{aligned}\theta^* &= \frac{k}{\frac{1}{\tau} - w} \\ \theta_L &= \frac{\frac{\mu}{\tau} - k}{w} \\ \theta_H &= \frac{k - \frac{1}{\tau} (1 - A_\rho) \mu}{\frac{1}{\tau} A_\rho - w} \\ \theta_T &= \frac{k - \frac{1}{\tau} (1 - \rho(T)) \mu}{\frac{1}{\tau} \rho(T) - w}\end{aligned} \tag{A.1}$$

An increase in τ lowers export profits for all firms. In a LQE, it widens the

range of non-exporters. In a HQE, it leads low-quality firms below θ^* to exit sooner. Also, holding constant the economy's exogenous parameters (α , δ , θ_m , k , and w), a higher τ makes it more likely that the steady-state equilibrium is a LQE. The existence condition for a HQE with tariffs is

$$\alpha \left(\frac{\theta_m \left(\frac{1}{\tau} - w \right)}{k} \right) + \frac{\delta}{1 - \delta} \left(\frac{\theta_m \left(\frac{1}{\tau} - w \right)}{k} \right)^\alpha > \alpha - 1 \quad (\text{A.2})$$

Case 1 *An increase in the ad-valorem tariff τ in a low-quality steady-state equilibrium:*

- (i) *Lowers θ_L and raises θ_H ;*
- (ii) *Lowers the average quality of exports and equilibrium country reputation*
if $\left(\frac{\frac{1}{\tau} \mu - k}{k - \frac{1}{\tau} (1 - A_\rho) \mu} \right)^{\alpha+1} \left(\frac{\frac{1}{\tau} A_\rho - w}{w} \right)^{\alpha-1} \left(1 - A_\rho + \frac{A_\rho \theta_H}{\mu} \right) > 1 - \delta$.

See Appendix A.1.10 for proofs. In a LQE, an increase in τ discourages entry by some relatively low-quality firms (as θ_L falls) as well as some relatively high-quality firms (as θ_H rises). Under the stated condition, the latter dominates in the net effect of τ on $\bar{\theta}$. Thus, a higher tariff, similarly to a higher k , results in lower steady-state quality in a LQE.

Case 2 *An increase in the ad-valorem tariff τ in a high-quality steady-state equilibrium:*

- (i) *Increases θ_T for all T and lowers the survival rate of exporters below θ^* ;*
- (ii) *Increases the average quality of exports and equilibrium country reputation.*

See Appendix A.1.10 for proofs. In a HQE, from an initial steady-state where $\bar{\theta} = \mu > \theta^*$, an increase in tariffs induces firms with below-average quality in (θ_m, θ^*) to exit sooner, and has no impact on the exit rate of firms with above-average quality ($\theta > \bar{\theta}$). Hence higher trade costs lead to a smaller mass of active exporters and a higher average quality of their products. Conversely, trade liberalization raises the

volume of exports and lowers their average quality in high-quality countries, but brings about better average quality and unit prices, as well as higher trade volume, in low-quality countries.

A.4 Hazard rates

We calculate hazard rates at the 10-digit product level in US manufacturing imports (SITC codes 5-8) over 1989-2006, using data from Robert Feenstra. HS-10 products in the data are the equivalent of firms in our model. The exit rate is calculated for each country, HS-2 industry and export duration. Specifically, the survival rate of products from country c , industry i and export experience s at time t is the number of 10-digit products that are exported to the US for the $(s + 1)$ -th time from country c in industry i , divided by the number of 10-digit products from the same country and industry that were exported at time $t - 1$ for the s -th time. The hazard rate is one minus the survival rate.

We find that across countries and industries, the average hazard rate falls with export experience. Furthermore, hazard rates for products from non-OECD members are higher than those of OECD members for all export durations, consistent with higher exit rates in countries exporting lower-quality goods.

Table A.1: Hazard rates in US manufacturing imports. HS-10 level, 1989-2006.

s	Hazard rate		
	All	OECD	Non-OECD
1	31.2%	23.2%	38.5%
2	20.2%	16.6%	24.2%
3	15.8%	13.5%	18.4%
4	13.6%	11.9%	15.7%
5	13.8%	13.0%	15.0%
6	10.9%	9.6%	12.4%
7	9.0%	7.7%	10.8%
8	7.5%	6.2%	9.2%
9	7.4%	6.3%	8.8%
10	8.5%	7.8%	9.2%

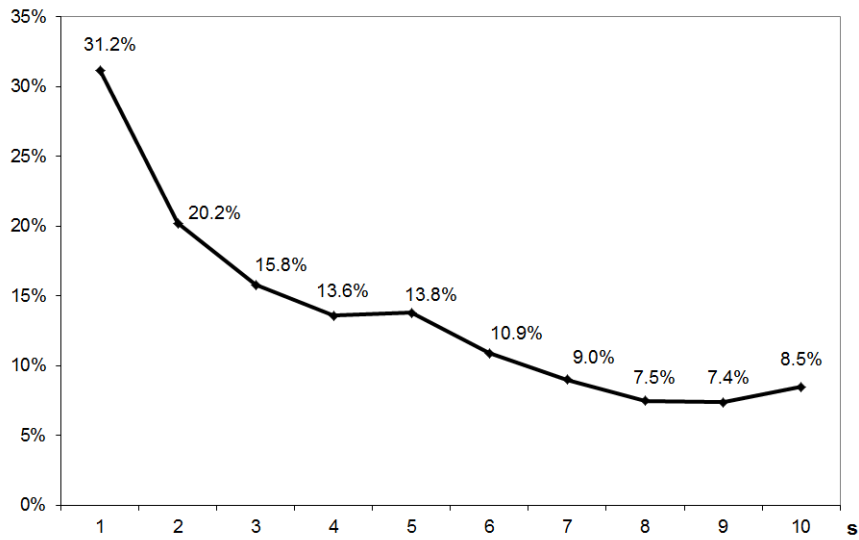


Figure A.1: Hazard rates of products from all countries with s years of export experience in US imports, 1989-2006

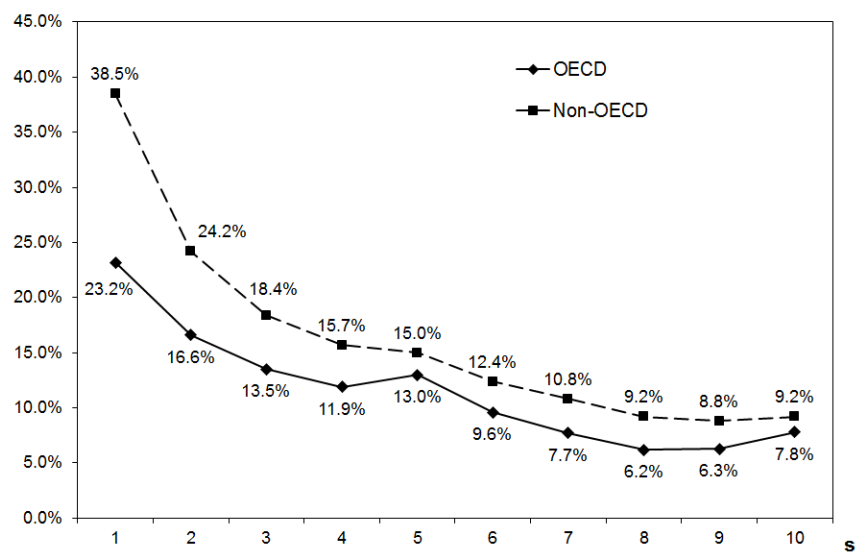


Figure A.2: Hazard rates of products from OECD and non-OECD countries with s years of export experience in US imports, 1989-2006

B. APPENDIX TO CHAPTER 2

B.1 Proofs

B.1.1 Proof of Lemma 2.1

Suppose $\gamma^*L > \gamma\underline{L}$. If θ satisfies (2.10) and (2.16), then borrowing on both markets yields expected profits of

$$\pi_{F,D} + \pi_{F,D}^* = 2 [2\theta\bar{R} - I] - p_{LL} [2\theta R_L - (\gamma + \gamma^*) L]$$

while home debt only yields

$$\pi_{I,D} + \pi_{I,D}^* = 2 [2\theta\bar{R} - I] - p_{LL} [2\theta R_L - \gamma (L + \underline{L})]$$

It immediately follows from $\gamma^*L > \gamma\underline{L}$ that $\pi_{I,D} + \pi_{I,D}^* < \pi_{F,D} + \pi_{F,D}^*$.

Similarly, if θ satisfies neither (2.10) nor (2.16), then borrowing on both markets yields expected profits of

$$\pi_{F,C} + \pi_{F,C}^* = 2 [2\theta\bar{R} - I] - p_L [2\theta R_L - (\gamma + \gamma^*) L]$$

while home debt only yields

$$\pi_{I,C} + \pi_{I,C}^* = 2 [2\theta\bar{R} - I] - 2\theta [p_{HL}R_H + p_L R_L] + (1 - p_{HH}) \gamma (L + \underline{L})$$

Again, it follows from $\gamma^* L > \gamma \underline{L}$ and $p_{HL} \geq 0$ that $\pi_{I,C} + \pi_{I,C}^* < \pi_{F,C} + \pi_{F,C}^*$.

Lastly, if (2.16) holds but (2.10) does not hold, there is diversification under home and local debt and contagion under home debt only. Since $\pi_{F,D} + \pi_{F,D}^* > \pi_{I,C} + \pi_{I,C}^*$, FDI with local borrowing strictly dominates FDI with parent financing.

B.1.2 Proof of Lemma 2.2

Suppose (2.16) holds. Then FDI with domestic and foreign debt yields

$$\pi_{F,D} + \pi_{F,D}^* = 2 [2\theta\bar{R} - I] - p_{LL} [2\theta R_L - (\gamma + \gamma^*) L]$$

while licensing yields

$$\pi_A + \pi_A^* = 2 [2\theta\bar{R} - I] - p_L [2\theta R_L - (\gamma + \gamma^*) L]$$

As long as $p_{HL} > 0$, $\pi_{F,D} + \pi_{F,D}^* > \pi_A + \pi_A^*$.

Suppose (2.16) does not hold. Then FDI with domestic and foreign debt yields

$$\begin{aligned} \pi_{F,C} + \pi_{F,C}^* &= 2 [2\theta\bar{R} - I] - p_L [2\theta R_L - (\gamma + \gamma^*) L] \\ &= \pi_A + \pi_A^* \end{aligned}$$

so FDI and licensing are equivalent in terms of expected profits.

B.1.3 Proof of Proposition 2.1

Lemma 2.1 rules out FDI with home debt only. Among firms active on their domestic market, we compare no foreign sales, affiliate sales with local debt, and licensing. By the definition of θ_A^* , arm's length technology transfer is not profitable

below θ_A^* . Similarly, in the diversification region, FDI with local debt is profitable if and only if

$$\theta \geq \theta_F^* \equiv \frac{I - \frac{1}{2}p_{LL}(\gamma + \gamma^*)L}{2\bar{R} - p_{LL}R_L}$$

Note that $\theta_F^* \leq \theta_A^*$. Equation (2.16) defines a threshold

$$\theta_F = \frac{I - \frac{1}{2}p_{LL}(\gamma + \gamma^*)L}{(1 - p_{LL})(R_H + R_L)}$$

such that (2.16) holds if and only if $\theta \geq \theta_F$. By Lemma 2.2, if $\theta \geq \theta_F$, FDI with domestic and foreign debt dominates licensing, and if $\theta < \theta_F$, FDI with domestic and foreign debt is equivalent to licensing. Hence, if $\theta_A^* < \theta_F$, then licensing is chosen whenever $\theta_A^* \leq \theta \leq \theta_F$, and FDI with local borrowing is chosen whenever $\theta > \theta_F \geq \theta_A^*$. If $\theta_A^* > \theta_F$, then whenever licensing is profitable, it is dominated by FDI. In this case there are no arm's length technology transfers, and we only observe FDI with local borrowing, whenever the firm is in the diversification zone and has positive profits, i.e. whenever $\theta \geq \max\{\theta_F^*, \theta_F\}$.

B.1.4 Proof of Lemma 2.3

Suppose $\gamma^*L < \gamma\underline{L}$. If θ satisfies (2.10) and (2.16), then borrowing on both markets yields expected profits of

$$\pi_{F,D} + \pi_{F,D}^* = 2[2\theta\bar{R} - I] - p_{LL}[2\theta R_L - (\gamma + \gamma^*)L]$$

while home debt only yields

$$\pi_{I,D} + \pi_{I,D}^* = 2[2\theta\bar{R} - I] - p_{LL}[2\theta R_L - \gamma(L + \underline{L})]$$

It immediately follows from $\gamma^*L < \gamma\underline{L}$ that $\pi_{I,D} + \pi_{I,D}^* > \pi_{F,D} + \pi_{F,D}^*$.

If (2.10) holds but (2.16) does not hold, there is diversification under home debt only and contagion under home and foreign debt. Borrowing on both markets yields expected profits of

$$\pi_{F,C} + \pi_{F,C}^* = 2 [2\theta\bar{R} - I] - p_L [2\theta R_L - (\gamma + \gamma^*) L]$$

which is lower than $\pi_{I,D} + \pi_{I,D}^*$ since $\gamma^*L < \gamma\underline{L}$ and $p_{HL} \geq 0$. FDI with parent financing still strictly dominates FDI with local borrowing.

Note that if neither (2.10) nor (2.16) holds, we are comparing

$$\begin{aligned} \pi_{F,C} + \pi_{F,C}^* &= 2 [2\theta\bar{R} - I] - p_L [2\theta R_L - (\gamma + \gamma^*) L] \\ &= \pi_A + \pi_A^* \end{aligned}$$

and

$$\pi_{I,C} + \pi_{I,C}^* = 2 [2\theta\bar{R} - I] - 2\theta [p_{HL}R_H + p_LR_L] + (1 - p_{HH}) \gamma (L + \underline{L})$$

The choice is determined by a tradeoff between borrowing costs and bankruptcy risk.

$$(\pi_{I,C} + \pi_{I,C}^*) - (\pi_A + \pi_A^*) = p_L (\gamma\underline{L} - \gamma^*L) - p_{HL} [2\theta R_H - \gamma (L + \underline{L})]$$

B.1.5 Proof of Lemma 2.4

Suppose (2.10) holds. Then FDI with home debt only yields

$$\pi_{I,D} + \pi_{I,D}^* = 2 [2\theta\bar{R} - I] - p_{LL} [2\theta R_L - \gamma (L + \underline{L})]$$

while licensing yields

$$\pi_A + \pi_A^* = 2 [2\theta\bar{R} - I] - p_L [2\theta R_L - (\gamma + \gamma^*) L]$$

Since $\gamma^* L < \gamma \underline{L}$ and $p_{HL} \geq 0$, $\pi_{I,D} + \pi_{I,D}^* > \pi_A + \pi_A^*$.

B.1.6 Proof of Proposition 2.2

Lemma 2.3 rules out FDI with local debt. If (2.10) holds, it is less profitable than FDI with home debt only, while if (2.10) does not hold, it is no better than licensing. Among firms active on their domestic market, we compare no foreign sales, affiliate sales with home debt only, and licensing.

(i) There is no production for the foreign market if neither licensing nor FDI with parent finance yields positive expected profits. By the definition of θ_A^* , arm's length technology transfer is not profitable below θ_A^* . Similarly, FDI with home debt only is profitable in the diversification region if and only if

$$\theta \geq \theta_I^* \equiv \frac{I - \frac{1}{2} p_{LL} \gamma (L + \underline{L})}{2\bar{R} - p_{LL} R_L}$$

and in the contagion region if and only if

$$\theta \geq \theta_I'^* \equiv \frac{I - \frac{1}{2} (1 - p_{HH}) \gamma (L + \underline{L})}{2\bar{R} - p_L R_L - p_{HL} R_H}$$

If $\theta_A^* < \min \{\theta_I'^*, \theta_I^*\}$, then the least productive active firms choose licensing, and the relevant threshold is θ_A^* . If $\theta_I < \min \{\theta_A^*, \theta_I'^*\}$, then all active firms are in the diversification region, choose FDI, and the relevant threshold is θ_I^* . If $\theta_I'^* < \min \{\theta_A^*, \theta_I^*\}$, then the least productive active firms choose FDI and are in the contagion region, so

that the relevant threshold is θ_I^* .

(ii) $\pi_A^* < 0$ if $\theta < \theta_A^*$. Comparing FDI and licensing, $\pi_A + \pi_A^* < \pi_{I,C} + \pi_{I,C}^*$ if $\theta < \theta_I' < \theta_I$, and $\pi_A + \pi_A^* < \pi_{I,D} + \pi_{I,D}^*$ if $\theta > \theta_I$. Therefore, licensing is the better option whenever $\theta_I' < \theta < \theta_I$. This is a situation in which the firm is in the contagion zone and the extra bankruptcy risk induced by a multinational firm is not made up for with lower borrowing costs on the home market.

(iii) Conversely, FDI with home borrowing only is strictly better than licensing whenever $\theta < \theta_I'$ or $\theta > \theta_I$. In the first case, it is profitable as long as $\theta > \theta_I^*$, and in the second case, whenever $\theta > \theta_I^*$, which completes the proof.

C. APPENDIX TO CHAPTER 3

C.1 Data on strategic rivalries

Thompson (2001) lists the following qualitative coding rules to define strategic rivalries and their duration for the period 1816-1999:

1. "Strategic rivals must be independent states, as determined by Gleditsch and Ward's (1999) inventory of independent states.
2. Beginning and ending dates are keyed as much as possible to the timing of evidence about the onset of explicit threat, competitor, and enemy perceptions on the part of decision-makers. Historical analyses, for instance, often specify that decision-makers were unconcerned about a competitor prior to some year just as they also provide reasonably specific information about the timing of rapprochements and whether they were meaningful ones or simply tactical maneuvers. [...]
3. As a general rule, the competitor criterion restricts rivalries to their own class within the major-minor power distinction. Major (minor) power rivalries are most likely to involve two major (minor) powers. Definitely, there are exceptions to this rule. Major-minor power rivalries emerge when minor powers become something more than nuisances in the eyes of major power decision-makers. Capability asymmetry may still be quite pronounced but that does not mean

that the major power is in a position to, or is inclined toward, the use of its capability advantage. [...]

4. No minimal duration is stipulated in advance [...]
5. Various constituencies within states may have different views about who their state's main rivals are or should be. Unless they control the government, constituency views are not considered the same as those of the principal decision-makers. If the principal decision-makers disagree about the identity of rivals, the operational problem then becomes one of assessing where foreign policy-making is most concentrated. [...]
6. If two states were not considered rivals prior to the outbreak of war, they do not become rivals during the war unless their rivalry extends beyond the period of war combat. This rule is designed to avoid complications in assessing the linkages between rivalry and intensive forms of conflict. [...]
7. One needs to be especially skeptical about dating rivalry terminations. Some rivalries experience short-lived and highly publicized rapprochements that turn out to be less meaningful than one might have thought from reading the relevant press accounts at the time. Some rivalries enter long periods of hibernation only to erupt suddenly as if nothing had changed. All of these situations may share the outward appearance of rivalry termination. What needs to be manifested is evidence of some explicit kind of a significant de-escalation in threat perceptions and hostility. [...]
8. The most valuable sources for information pertinent to identifying strategic rivalry are political histories of individual state's foreign policy activities."

C.2 *Primary enrollment, wars and democratization*

This Appendix presents the data underlying Table 3.1. For each of the 53 countries for which we have more than 40 years of education data, we list (i) the 20-year period with the highest observed increase in primary enrollment rates; (ii) the date, if any, in which the country became a democracy as measured by crossing the threshold of 6 in the *polity2* scale; (iii) the wars in which the country was engaged in the 20 years prior to the observed surge in primary education.

(*) The democratic transition is identified as the first year in which the Polity IV index reached 6 (when the index is greater than 6 at the beginning of the Polity IV sample, the cell indicates: > 6 in beginning date of sample).

(**) Wars are identified from the Correlates of War database; strategic rivalries are identified from Thompson (2001).

Country	Availability of data on primary enrollment rate	Education reform period (20-year period with greatest increase in primary enrollment)	Date of democratic transition (*)	Rivalries and wars starting in a 20-year period before education reform (**)
Afghanistan	1946-1998	1946-1966	Always < 6	Second Afghan Anti-Reform War of 1928-1937 (intra-state) Strategic rivalry with Iran, 1816-1929 Strategic rivalry with Pakistan, 1947-1979 Second World War of 1939-1945
Albania	1919-1998	1934-1954	2002	Strategic rivalry with Greece, 1913-1987 First World War of 1914-1918
Argentina	1882-1998	1889-1919	1983	Lopez War of 1864-1870 Fourth Argentina War of 1870-1871 (intra state) Fifth Argentina War of 1874 (intra state) Argentine Indians War of 1879-1880 (intra state)
Belgium	1860-1980	1889-1919	1853	None
Bolivia	1882-1981	1882-1902	1982	War of the Pacific of 1879-1883
Brazil	1868-1981	1946-1966	1985	Bolivia-Carlos War of 1870-1871 (intra state war) Second World War of 1939-1945
Bulgaria	1889-1985	1889-1909	1990	Bosnia and Bulgaria Revolt of 1875-1876 (intra state war) Serbian-Bulgarian War of 1885 Strategic rivalry with Greece 1878-1953 Strategic rivalry with Romania 1878-1945 Strategic rivalry with Turkey 1878-1950 Strategic rivalry with Yugoslavia 1878-1954 Second World War of 1939-1945
Canada	1865-1980	1946-1966	1888	Second World War of 1939-1945
Chile	1882-1980	1893-1913	1965	War of the Pacific of 1879-1883
China	1919-1998	1938-1958	Always < 6	Manchurian War of 1929 Intra-Guomindang War of 1929-1930 (intra state war) Second Sino-Japanese War of 1931- Third Sino-Japanese War of 1937-1941
Columbia	1886-1980	1893-1913	1867	None
Costa Rica	1882-1980	1946-1966	1875	Second World War of 1939-1945
Cuba	1902-1980	1954-1974	Always < 6	Second World War of 1939-1945
Czechoslovakia	1919-1992	1943-1963	> 6 in 1918	No data
Denmark	1882-1980	1882-1902	1911	Second Schleswig-Holstein War of 1864
Dominican Republic	1865-1980	1900-1920	1978	None in dataset
Ecuador	1886-1980	1946-1966	1979	Second World War of 1939-1945
Finland	1919-1980	1919-1939	> 6 in 1918	Kinship Wars from 1918-1920
France	1815-1981	1827-1847	1876	Franco-Spanish War of 1823
Germany	1867-1939	1867-1887	1919	Second Schleswig-Holstein War of 1864
Greece	1860-1980	1913-1933	1864	Greco-Turkish War of 1897 First Balkan War of 1912-1913
Guatemala	1882-1980	1947-1967	1996	Second World War of 1939-1945
Haiti	1905-1981	1907-1927	1990	Strategic Rivalry with the United States 1891-1915
Honduras	1882-1980	1946-1966	1982	Second World War of 1939-1945
Hungary	1919-1980	1926-1946	1990	First World War of 1914-1918 Hungarian Adversaries War of 1919
Iran	1889-1980	1889-1909	Always < 6	None

Figure C.1: Education surge, democratic transition and wars: Details

Country	Availability of data on primary enrollment rate	Education reform period (20-year period with greatest increase in primary enrollment)	Date of democratic transition (*)	Rivalries and wars starting in a 20-year period before education reform (**)
Ireland	1922-1980	1946-1966	Above 6 in 1922	Second World War of 1939-1945
Italy	1882-1980	1889-1919	1947	First Italian-Ethiopian War of 1887
Japan	1867-1998	1867-1887	1952	Convention of Kanagawa of 1854 (with US) Anglo-Japanese Friendship Treaty of 1854 Treaty of Shimoda of 1855 (with Russia) United-States Japan Treat of Amity and Commerce of 1858 Treaty of Amity and Commerce between France and Japan of 1858
Liberia	1887-1980	1946-1966	2006	Second World War of 1939-1945
Luxemburg	1886-1981	1926-1946	No data	First World War of 1914-1918
Mexico	1882-1980	1919-1939	1997	Third Mexican War of 1910-1914
Mongolia	1926-1980	1930-1950	1992	First World War of 1914-1918
Netherlands	1857-1980	1899-1919	1917	Conquest of Mongolia of 1920-1921 First Dutch-Achinese War of 1873-1878
New Zealand	1907-1980	1946-1966	Above 6 in 1907	Second World War of 1939-1945
Nicaragua	1902-1980	1939-1959	1990	No data
Norway	1830-1981	1960-1980	1898	Second World War of 1939-1945
Panama	1903-1980	1906-1926	1989	Enduring rivalry with Russia 1956-1987 Panama seceded from Colombia with the backing of the United States in 1903
Paraguay	1882-1980	1882-1902	1992	Lopez War of 1864-1870
Peru	1886-1980	1930-1960	1980	First World War of 1914-1918
Poland	1919-1980	1946-1966	Above 6 in 1918	Second World War of 1939-1945
Portugal	1854-1980	1854-1874	1911	No data
Romania	1882-1980	1893-1913	1996	None
Spain	1859-1980	1919-1939	1900	Second Spanish-Moroccan War of 1909-1910 First World War of 1914-1918
Sweden	1882-1980	1939-1959	1914	None
Switzerland	1880-1982	1930-1959	Above 10 in 1880	No
Thailand	1887-1980	1919-1939	1992	First World War of 1914-1918
Turkey	1886-1980	1886-1906	1960	Second Russo-Turkish War of 1877-1878
United Kingdom	1860-1980	1860-1980	1880	Second Russo-Burmese War of 1852 Crimean War of 1853-1856 Anglo-Persian War of 1856-1857 Indian Mutiny of 1857-1859
United States	1825-1982	1860-1980	1809	Mexican-American War of 1846-1847
Uruguay	1882-1980	1946-1966	1952	Second World War of 1939-1945
Venezuela	1886-1980	1919-1939	1958	First World War of 1914-1939
Yugoslavia	1919-1980	1930-1950	2000	First World War of 1914-1939

Figure C.1: Education surge, democratic transition and wars: Details (continued)

BIBLIOGRAPHY

- ACEMOGLU, D., AND P. YARED (2010): "Political Limits to Globalization," *American Economic Review: Papers & Proceedings*, Vol. 100, 83–88.
- AGHION, P., M. ANGELETOS, A. BANERJEE, AND K. MANOVA (2010): "Volatility and Growth: Credit Constraints and the Composition of Investment," *Journal of Monetary Economics*, Vol. 57, 246–265.
- AGHION, P., M. DEWATRIPONT, L. DU, A. HARRISON, AND P. LEGROS (2011): "Industrial Policy and Competition," Working Paper.
- ALESINA, A., D. DEVLEESCHAUWER, W. EASTERLY, S. KURLAT, AND R. WACZIARG (2003): "Fractionalization," *Journal of Economic Growth*, Vol. 8, 155–194.
- ALGAN, Y., P. CAHUC, AND A. SHLEIFER (2011): "Teaching Practices and Social Capital," Harvard University Working Paper.
- ANDERTON, C., AND J. CARTER (2001): "The Impact of War on Trade: An Interrupted Times-Series Study," *Journal of Peace Research*, Vol. 38(4), 445–457.
- ANTRÀS, P., M. A. DESAI, AND C. F. FOLEY (2009): "Multinational Firms, FDI Flows, and Imperfect Capital Market," *The Quarterly Journal of Economics*, Vol. 124(3), 1171–129.
- ARAUJO, L., AND E. ORNELAS (2007): "Trust-Based Trade," *CEP Discussion Paper*, No. 820.
- ARKOLAKIS, C. (2010): "Market Penetration Costs and the New Consumers Margin in International Trade," *Journal of Political Economy*, Vol. 118(6), 1151–1199.
- AW, B. Y., S. CHUNG, AND M. J. ROBERTS (1998): "Productivity and the Decision to Export: Micro Evidence from Taiwan and South Korea," *NBER Working Paper*, No. 6558.
- BAGWELL, K., AND R. W. STAIGER (1989): "The Role of Export Subsidies When Product Quality Is Unknown," *Journal of International Economics*, Vol. 27, 69–89.

- BALASSA, B., AND M. NOLAND (1989): "The Changing Comparative Advantage of Japan and the United States," *Journal of the Japanese and International Economies*, Vol. 3, 174–188.
- BALDWIN, R., AND J. HARRIGAN (2007): "Zeros, Quality and Space: Trade Theory and Trade Evidence," *NBER Working Paper*, No. 13214.
- BANKS, A. S. (2011): "Cross-National Time-Series Data Archive. Databanks International," .
- BARRO, R., AND J.-W. LEE (2010): "A New Data Set of Educational Attainment in the World, 1950–2010," *NBER Working Paper*, No. 15902.
- BERGEMANN, D., AND J. VÄLIMÄKI (1996): "Learning and Strategic Pricing," *Econometrica*, Vol. 64(5), 1125–1149.
- (2006): "Dynamic Pricing of New Experience Goods," *Journal of Political Economy*, Vol. 114(4), 713–744.
- BESEDES, T., AND T. J. PRUSA (2004): "Surviving the US Import Market: The Role of Product Differentiation," *NBER Working Paper*, No. 10319.
- BESLEY, T., AND R. BURGESS (2002): "The Political Economy of Government Responsiveness: Theory and Evidence from India," *The Quarterly Journal of Economics*, Vol. 117(4), 1415–1451.
- BESLEY, T., AND T. PERSSON (2009): "The Origins of State Capacity: Property Rights, Taxation, and Politics," *The American Economic Review*, Vol. 99(4), 1218–1244.
- (2011): *Pillars of Prosperity: The Political Economics of Development Clusters*. Princeton University Press.
- BLOCK, R. (1995): "Der Alphabetisierungsverlauf im Preussen des 19. Jahrhunderts: Quantitative Explorationen aus bildungshistorischer Perspektive," *European University Studies*, Series XI, Education.
- BLOMBERG, S., AND G. HESS (2006): "How Much Does Violence Tax Trade?," *Review of Economics and Statistics*, Vol. 88(4), 599–612.
- BOURGUIGNON, F., AND T. VERDIER (2000): "Oligarchy, Democracy, Inequality and Growth," *Journal of Development Economics*, Vol. 62(2), 285–313.
- BRANDER, J. A., AND B. J. SPENCER (1985): "Export Subsidies and International Market Share Rivalry," *Journal of International Economics*, Vol. 18, 83–100.

- BRUSCO, S., AND F. PANUNZI (2005): "Reallocation of Corporate Resources and Managerial Incentives in Internal Capital Markets," *European Economic Review*, Vol. 49, 659–681.
- BURNETT, J., AND Y. WADA (2007): "The Ebb and Flow of Japanese Educational Reform," *Australian Association for Research in Education*.
- BURSZTYN, L. (2011): "'Electoral Incentives and Public Education Spending: Evidence from Brazil," Working paper, UCLA.
- CALDERÓN, C., AND L. SERVÉN (2010): "Infrastructure in Latin America," *World Bank Policy Research Working Paper*, No. 5317.
- CHANEY, T. (2005): "Liquidity Constrained Exporters," Working paper.
- CHISIK, R. (2003): "Export Industry Policy and Reputational Comparative Advantage," *Journal of International Economics*, Vol. 59, 423–451.
- COATE, S., AND M. CONLIN (2004): "A Group Rule Utilitarian Approach to Voter Turnout: Theory and Evidence," *The American Economic Review*, Vol. 94(5), 1476–1504.
- DASGUPTA, K., AND J. MONDRIA (2011): "Quality Uncertainty and Intermediation in International Trade," Working paper.
- DELLA VIGNA, S., AND E. KAPLAN (2007): "The Fox News Effect: Media Bias and Voting," *The Quarterly Journal of Economics*, Vol. 122(3), 1187–1234.
- DEMIDOVA, S., AND A. RODRIGUEZ-CLARE (2009): "Trade Policy under Firm-Level Heterogeneity in a Small Economy," *Journal of International Economics*, Vol. 78, 100–112.
- DESAI, M. A., C. F. FOLEY, AND K. J. FORBES (2008): "Financial Constraints and Growth: Multinational and Local Firm Responses to Currency Depreciations," *The Review of Financial Studies*, Vol. 21(6), 2857–2888.
- DESAI, M. A., C. F. FOLEY, AND J. R. HINES (2004): "A Multinational Perspective on Capital Structure Choice and Internal Capital Markets," *The Journal of Finance*, Vol. 59(6), 2451–2487.
- (2006): "Capital Controls, Liberalizations, and Foreign Direct Investment," *The Review of Financial Studies*, Vol. 19(4), 1434–1464.
- (2007): "Dividend Policy inside the Multinational Firm," *Financial Management*, Vol. 36(1), 5–26.

- DISDIER, A.-C., AND T. MAYER (2006): "Je t'aime, moi non plus: Bilateral opinions and international trade," *CEPII Working Paper*, Vol. 01.
- DOLMAN, E. (2004): *The Warrior State*. Palgrave-McMillan.
- DUKE, B. (2009): *The History of Modern Japanese Education: Constructing the National School System (1872-1890)*. Rutgers University Press.
- DYCK, A. (1992): "The Competitive Consequences of Japan's Export Cartel Associations," *Journal of the Japanese and International Economies*, Vol. 6, 275-298.
- DYCK, A., AND L. ZINGALES (2003): "The Media and Asset Prices," Working paper.
- FAJGELBAUM, P. D., G. M. GROSSMAN, AND E. HELPMAN (2009): "Income Distribution, Product Quality, and International Trade," *NBER Working Paper*, No. 15329.
- FARRELL, J. (1986): "Moral Hazard as an Entry Barrier," *The RAND Journal of Economics*, Vol. 17(3), 440-449.
- FEDDERSEN, T., AND A. SANDRONI (2006): "A Theory of Participation in Elections," *The American Economic Review*, Vol. 96(4), 1271-1282.
- FEENSTRA, R. C., J. ROMALIS, AND P. K. SCHOTT (2002): "U.S. Imports, Exports and Tariff Data, 1989-2001," NBER.
- FEINBERG, S., AND G. PHILLIPS (2002): "Firm-Specific Resources, Financial Market Development and the Growth of US Multinationals," *NBER Working Paper*, No. 9252.
- FLAM, H., AND E. HELPMAN (1987): "Industrial Policy under Monopolistic Competition," *Journal of International Economics*, Vol. 22, 79-102.
- FLORA, P., AND J. ALBER (1983): *State, Economy, and Society in Western Europe, 1815-1975*. Chicago: St. James Press.
- FORD, S. (1965): *Stein and the Era of Reform in Prussia (1807-1815)*. Princeton University Press.
- FOSTER, L., J. HALTIWANGER, AND C. SYVERSON (2008): "Reallocation, Firm Turnover, and Efficiency: Selection on Productivity or Profitability?," *The American Economic Review*, Vol. 98(1), 394-425.
- FREEDMAN, S. M., M. S. KEARNEY, AND M. LEDERMAN (2009): "Product Recalls, Imperfect Information, and Spillover Effects: Lessons from the Consumer Response to the 2007 Toy Recalls," *NBER Working Paper*, No. 15183.

- GALOR, O., AND O. MOAV (2006): "Das Human Kapital: A Theory of the Demise of the Class Structure," *Review of Economic Studies*, Vol. 73, 85–117.
- GALOR, O., O. MOAV, AND D. VOLLRATH (2009): "Inequality in Land ownership, the Emergence of Human Capital Promoting Institutions and the Great Divergence," *Review of Economic Studies*, Vol. 76, 143–179.
- GENTZKOW, M. A., J. M. SHAPIRO, AND M. SINKINSON (2011): "The Effect of Newspaper Entry and Exit on Electoral Politics," *American Economic Review*, forthcoming.
- GERTNER, R. H., D. S. SCHARFSTEIN, AND J. C. STEIN (1994): "Internal Versus External Capital Markets," *The Quarterly Journal of Economics*, Vol. 109(4), 1211–1230.
- GIDDENS, A. (1985): *The Nation State and Violence*. University of California Pres.
- GLAESER, E., G. PONZETTO, AND A. SHLEIFER (2007): "Why Does Democracy Need Education?," *Journal of Economic Growth*, Vol. 12(2), 77–99.
- GLICK, R., AND A. TAYLOR (2005): "Collateral Damage: Trade Disruption and The Economic Impact of War," *NBER Working Paper*, No. 11565.
- GORDON, A. (2000): *Japan's March Toward Militarism*. Wesleyan.Edu.
- GRAY, M. (1986): *Prussia in Transition: Society and Politics Under the Stein Reform Ministry of 1808*. The American Philosophical Society, Philadelphia.
- GREENWALD, B., AND J. E. STIGLITZ (2006): "Helping Infant Economies Grow: Foundations of Trade Policies for Developing Countries," *The American Economic Review*, Vol. 96(2), 141–146.
- GROSSMAN, G. M., AND H. HORN (1988): "Infant-Industry Protection Reconsidered: The Case of Informational Barriers to Entry," *The Quarterly Journal of Economics*, Vol. 103(4), 767–787.
- GUIZO, L., P. SAPIENZA, AND L. ZINGALES (2009): "Cultural Biases in Economic Exchange?," *The Quarterly Journal of Economics*, Vol. 124(3), 1095–1131.
- HALLAK, J. C., AND J. SIVADASAN (2009): "Firms' Exporting Behavior Under Quality Constraints," *NBER Working Paper*, No. 14928.
- HARRISON, A., AND A. RODRÍGUEZ-CLARE (2009): "Trade, Foreign Investment, and Industrial Policy for Developing Countries," *NBER Working Paper*, No. 15261.
- HEAD, K., T. MAYER, AND J. RIES (2010): "The Erosion of Colonial Trade Linkages after Independence," *Journal of International Economics*, Vol. 81(1), 1–14.

- HELPMAN, E., M. J. MELITZ, AND S. R. YEAPLE (2004): "Export Versus FDI with Heterogeneous Firms," *The American Economic Review*, Vol. 94(1), 300–316.
- HINTZE, O. (1975): "Military Organization and the Organization of the State," *The Historical Essays of Otto Hintze*, ed. Felix Gilbert, Oxford University Press.
- HOFF, K. (1997): "Bayesian Learning in an Infant Industry Model," *Journal of International Economics*, Vol. 43, 409–436.
- HUBBARD, G., AND D. PALIA (1999): "A Reexamination of the Conglomerate Merger Wave in the 1960s: An Internal Capital Markets View," *The Journal of Finance*, Vol. 54(3), 1131–1152.
- IMBS, J. M., H. MUMTAZ, M. O. RAVN, AND H. REY (2010): "One TV, One Price?," *The Scandinavian Journal of Economics*, Vol. 112(4), 753–781.
- INDERST, R., AND H. M. MULLER (2003): "Internal versus External Financing: An Optimal Contracting Approach," *The Journal of Finance*, Vol. 58(3), 1033–1062.
- JOHNSON, R. C. (2010): "Trade and Prices With Heterogeneous Firms," Working paper.
- KHANDELWAL, A. (2010): "The Long and Short (of) Quality Ladders," *Review of Economic Studies*, Vol. 77(4), 1450–1476.
- KUGLER, M., AND E. A. VERHOOGEN (2011): "Prices, Plant Size, and Product Quality," *Review of Economic Studies*, forthcoming.
- LARSON, J. F., AND H.-S. PARK (1993): *Global Television and the Politics of the Seoul Olympics*. Boulder, Colo. : Westview Press.
- LEVY, B. (1991): "Transactions Costs, the Size of Firms and Industrial Policy: Lessons from a Comparative Case Study of the Footwear industry in Korea and Taiwan," *Journal of Development Economics*, Vol. 34, 151–178.
- LIEBESKIND, J., AND R. P. RUMELT (1989): "Markets for Experience Goods with Performance Uncertainty," *The RAND Journal of Economics*, Vol. 20(4), 601–621.
- LINDERT, P. (2004): *Growing Public : Social Spending and Economic Growth since The Eighteenth Century*. Cambridge University Press.
- LOTT, J. (1999): "Public Schooling, Indoctrination, and Totalitarianism," *Journal of Political Economy*, Vol. 107, S127–S157.
- LYNN, L., AND T. J. McKEOWN (1988): "Organizing Business: Trade Associations in America and Japan," American Enterprise Institute.

- MAKSIMOVIC, V., AND G. PHILLIPS (2007): "Conglomerate Firms and Internal Capital Markets," *Handbook of Corporate Finance: Empirical Corporate Finance*, Vol. 1, chapter 8.
- MANOVA, K. (2011): "Credit Constraints, Heterogeneous Firms, and International Trade," *NBER Working Paper*, p. No. 14531.
- MANOVA, K., AND Z. ZHANG (2011): "Export Prices across Firms and Destinations," *The Quarterly Journal of Economics*, forthcoming.
- MARIN, D., AND M. SCHNITZER (2011): "When is FDI a Capital Flow?," *European Economic Review*, Vol. 55, 845–861.
- MARTIN, P., T. MAYER, AND M. THOENIG (2008a): "Civil Wars and International Trade," *Journal of the European Economic Association, Papers and Proceedings*, Vol. 6(3), 541–550.
- (2008b): "Make Trade Not War?," *Review of Economic Studies*, Vol. 75(3), 865–900.
- MELITZ, M. (2003): "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity," *Econometrica*, Vol. 71(6), 1695–1725.
- MICHAELS, G., AND X. ZHI (2010): "Freedom Fries," *American Economic Journal: Applied Economics*, Vol. 2, 256–281.
- MOODY, J. (1978): *French Education Since Napoleon*. Syracuse University Press.
- MULLIGAN, C., X. SALA-I MARTIN, AND R. GIL (2004): "Do Democracies Have Different Public Policies than Nondemocracies?," *Journal of Economic Perspectives*, Vol. 18, 51–74.
- NELSON, P. (1970): "Information and Consumer Behavior," *The Journal of Political Economy*, Vol. 78(2), 311–329.
- NOE, T. H. (1999): "Creditor Rights and Multinational Capital Structure," Working paper.
- OZBAS, O., AND D. S. SCHARFSTEIN (2010): "Evidence on the Dark Side of Internal Capital Markets," *Review of Financial Studies*, Vol. 23(2), 581–599.
- PACK, H., AND L. WESTPHAL (1986): "'Industrial Strategy and Technical Change: Theory versus Reality'," *Journal of Development Economics*, Vol. 22, 87–128.
- RAJAN, R., H. SERVAES, AND L. ZINGALES (2000): "The Cost of Diversity: The Diversification Discount and Inefficient Investment," *The Journal of Finance*, Vol. 55(1), 35–80.

- RAMONDO, N., AND V. RAPPOPORT (2008): "The Role of Multinational Production in Cross-Country Risk Sharing," Working paper.
- RAUCH, J. E., AND J. WATSON (2003): "Starting Small in an Unfamiliar Environment," *International Journal of Industrial Organization*, Vol. 21, 1021-1042.
- RIORDAN, M. H. (1986): "Monopolistic Competition with Experience Goods," *The Quarterly Journal of Economics*, Vol. 101(2), 265-280.
- RODRIG, D. (1995): "Getting Interventions Right: How South Korea and Taiwan Grew Rich," *Economic Policy*, Vol. 20, 55-107.
- ROTH, K. P., AND A. DIAMANTOPOULOS (2009): "Advancing the Country Image Construct," *Journal of Business Research*, Vol. 62, 726-740.
- SCHARFSTEIN, D. S., AND J. C. STEIN (2000): "The Dark Side of Internal Capital Markets: Divisional Rent-Seeking and Inefficient Investment," *The Journal of Finance*, Vol. 55(6), 2537-2564.
- SCHEVE, K., AND D. STASAVAGE (2011): "Democracy, War, and Wealth: Lessons from Two Centuries of Inheritance Taxation," *American Political Science Review*, Vol. 106, 81-102.
- SCHOTT, P. K. (2004): "Across-Product versus Within-Product Specialization in International Trade," *The Quarterly Journal of Economics*, Vol. 119(2), 647-678.
- (2008): "The Relative Sophistication of Chinese Exports," *Economic Policy*, pp. 5-49.
- SEGURA-CAYUELA, R., AND J. M. VILARRUBIA (2008): "Uncertainty and Entry Into Export Markets," *Bank of Spain Working Paper*, No. 0811.
- SHAPIRO, C. (1983): "Optimal Pricing of Experience Goods," *The Bell Journal of Economics*, Vol. 14(2), 497-507.
- STEIN, J. C. (1997): "Internal Capital Markets and the Competition for Corporate Resources," *The Journal of Finance*, Vol. 52(1), 111-133.
- (2003): "Agency, Information and Corporate Investment," *Handbook of the Economics of Finance*, Chapter 2, 111-165.
- SULLIVAN, M. (1990): "Measuring Image Spillovers in Umbrella-Branded Products," *The Journal of Business*, Vol. 63(3), 309-329.
- THIES, C. (2004): "State Building, Interstate and Intrastate Rivalry: A Study of Post-Colonial Developing Country Extractive Efforts, 1975-2000," *International Studies Quarterly*, Vol. 48, 53-72.

- THOMPSON, W. (2001): "Identifying Rivals and Rivalries in World Politics," *International Studies Quarterly*, Vol. 45, 557–586.
- TICCHI, A., AND A. VINDIGNI (2009): "War and Endogenous Democracy," Working paper, Princeton.
- TILLY, C. (1975): "Reflection on the History of the European State-Making," *The Formation of National States in Western Europe*, ed. C. Tilly, Princeton University Press.
- UMBACH, M. (2003): "Made in Germany," *Universitas*, Vol. 9/26, 5–37.
- VERHOOGEN, E. A. (2008): "Trade, Quality Upgrading, and Wage Inequality in the Mexican Manufacturing Sector," *The Quarterly Journal of Economics*, Vol. 123(2), 489–530.
- WEBER, E. (1979): *Peasants into Frenchmen : The Modernization of Rural France, 1870-1914*. Chatto & Windus.
- WESTPHAL, L. (1990): "Industrial Policy in an Export-Propelled Economy: Lessons from South Korea's Experience," *Journal of Economic Perspectives*, Vol. 4, 41–59.
- WORLD BANK, T. (1993): *The East Asian Miracle: Economic Growth and Public Policy*. Oxford University Press for the World Bank.
- WULF, J. (2009): "Influence and Inefficiency in the Internal Capital Market," *Journal of Economic Behavior & Organization*, Vol. 72, 305–321.